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CLEARER THINKING

(LOGIC FOR EVERYMAN)

BY

A. E. MANDER

Author of

"PSYCHOLOGY FOR EVERYMAN (AND WOMAN)"

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"The trouble with most folks is not so much their ignorance, as their '*knowing*' so many things which *ain't* so."

(JOSH BILLINGS.)

¤ ¤

'He who cannot reason is a fool; he who will not is a bigot; he who dare not is a slave."

(W. DRUMMOND.)

¤ ¤

"Every argument that has been used to justify the teaching of grammar may be applied with greater cogency to the teaching of logic. If it is desirable that a person shall *speak* correctly, it is much more desirable that he shall *think* correctly."

(BALLARD.)

FOREWORD

Thinking is skilled work. It is not true that we are naturally endowed with the ability to think clearly and logically—without learning how, or without practising. It is ridiculous to suppose that any less skill is required for thinking than for carpentering, or for playing tennis, golf, or bridge, or for playing some musical instrument. *People with untrained minds should no more expect to think clearly and logically than people who have never learnt and never practised can expect to find themselves good carpenters, golfers, bridge-players, or pianists.* Yet our world is full of people who apparently do suppose that thinking is entirely unskilled work; that thinking clearly and accurately is so easy and so "natural" that nobody need trouble to learn how to do it; that "anybody can think"; and that any one person's thinking is quite as reliable as any other person's. This accounts for the fact that, as a people, we are so much less efficient in this respect than we are in our sports. For nobody assumes that any *game* is so easy that we are all first-class players "naturally," without having to learn how to play or without practice.

Those who are in earnest in wishing to think more clearly, more accurately, and more rationally should face their task in the spirit in which they would set themselves to learn the rules, to learn the technique, and to practise some new game. They should be prepared to devote as much time and attention to this as they would to learning golf, bridge, or music.

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SECTION I

CHECKS AND SAFEGUARDS

STICKING TO THE POINT

The first essential to clear thinking (and speaking) is the ability to 'see' the point—to recognize what exactly is the point in question—and then to stick to that point until it has been dealt with.

It is the mark of a vague, muddled, and feeble thinker (or speaker) that he drifts always from one point to another; wandering hither and thither; never settling anything; quitting each question in turn as soon as another attracts his attention; leaving every "hare" immediately another is started, and following that one only until yet another appears; "mind wandering"; not thinking.

A clear thinker 'sees' the point at issue; recognizes exactly what it is he wants to know, or wants to decide; sets to work to sort out all the relevant facts and arguments from others which are irrelevant; considers only those which are relevant to the question before him; *thinks always with purpose*, keeping steadily in mind the question that is to be answered, the problem that is to be solved.

All real, constructive thinking is aimed at answering

some question, solving some problem, making some decision. Much of what is commonly called thinking (and much talking) is indeed nothing more than "mind wandering".

Let us cultivate the habit of considering one point at a time, and sticking to that point until we have made up our minds about it. Let us not drift about from one question to another, in the end leaving everything 'in the air', unsettled, unsolved. *The best way to develop as clear thinkers is to think always by the method of asking ourselves questions and then striving to answer them; and always answering each question before passing on to the next.* It is useful to state the question definitely—if possible, to put it down in writing—and then refer to it, and come back to it again and again and again.

SPEAKING THE SAME LANGUAGE

To say that two persons speak the *same language* is to say that they use the *same words* with the *same meanings*. When we say that we are all English-speaking people, that signifies only that the majority of everyday words mean more or less the same thing to all of us. But there are many words which have different meanings to different persons. Probably no two persons speak exactly the same language.

We should note that a language is not merely a collection of words: it is the relation of words to

meanings. To speak or write the same words does not of itself show that we are using the same language. The word "genial" occurs in both German and English; but if a German were to use the word in the German sense and we were to accept it in the English sense, we should completely misunderstand him. The word "lovely" is commonly used in slightly different senses in England and New Zealand. The word "Solicitor" means something quite different in America from what it means in England: in America it means one who solicits orders, a salesman or commercial traveller; in English it means a lawyer. "Dumb", likewise, has a meaning in America different from the meaning it has in England.

Again, there is a word, "conscience", in both French and English. But if a Frenchman were to use the word in the French sense, and we were to accept it in the English sense, we should entirely misunderstand his meaning. We speak different languages. Yet because German and French and English are so widely different, we are not likely to be misled when a German or a Frenchman, speaking his language, happens to use a word which occurs in our language too. We recognize that we speak different languages; and so we are on our guard against confusing his use of the word with our own.

The word "homely" occurs in both English and American-English. To most Englishmen "a homely girl" is an expression with quite an agreeable flavour: it means a pleasant, natural sort of girl who possesses the domestic qualities which would make her a good wife and mother. But it would be unwise to describe

such a girl as "homely" to an American. For to him the word has a different meaning: to him it means plain and unattractive, coarse and ugly. So, in regard to this word at any rate, the English and the Americans are speaking different languages.

There is probably less danger of misunderstanding when we are dealing with Germans than when we are dealing with Americans. For in the former case we *recognize* that we are speaking different languages. We are therefore on our guard; and in translating from one language to the other we exercise great care to get the exact meaning intended—what the word really means to the person who uses it. But in dealing with Americans we may suppose that we are speaking the same language; and so we are apt to take it for granted that a given word must mean the same thing to them that it means to us. The word "homely" is but one of hundreds of cases in which a complete misunderstanding may result.

* * * * *

But what of ourselves? Of us, apart from the Americans, who call ourselves English-speaking people? Do *we* all speak exactly the same language? I repeat: we do not. We all speak languages which are more or less similar; and for the sake of rough-and-ready convenience we lump them all together as the English language. But when we come to look into the matter more closely, we find that our respective languages are not entirely and exactly the same language.

I repeat: to say that two persons use the same language, is to say that they use the *same words* with

the *same meaning*. No doubt there are many English words which do have approximately the same meaning to all of us. If there were not, we could not understand one another at all. *But consider how many words there are—how many everyday English words—which mean different things to different people.* And can you say that two persons are really speaking the same language if—even though they use the same words—they mean different things by them? Can you? Think it over.

* * * * *

Suppose that when I use the word "Elephant", I mean the same thing that *you* mean when you use the word "Camel". Obviously, in that case, you and I will be 'all at sea' if we try to talk to one another about elephants or camels. You will be meaning one thing, and I another. In that respect, at any rate, we shall be speaking different languages. We shall be in the position of a Frenchman and a Chinese (neither of whom understands the other's language) trying to carry on a conversation. Indeed, we shall be in a worse position. For we may take it for granted that we are speaking the same language, whereas they will realize that they are not. I assume that the word "Elephant" means the same to you as to me. You assume that it means the same to me as to you. And if it does not, then our argument (as to whether an elephant has a trunk) is liable to become somewhat heated. You will think that I am a fool: I shall think that you are one. We shall perhaps grow angry or contemptuous. The argument will become more and more involved, incoherent, absurd. And this is the usual result

when two persons are talking to each other in different languages and yet mistake them for the same language.

Obviously, it is not likely that you and I speak different languages in regard to the word " Elephant ". For, if we have the slightest doubt about it, I can take you to the Zoo and point to an animal, or show you a picture, or describe the creature in words, and say: " There! See! *That* is what the word ' Elephant ' means to me ".

It is with abstract terms that we chiefly experience difficulty. Consider a word like " *Socialism* ". Sir William Harcourt is reported once to have said: " We are all Socialists nowadays ". The leader of the Labour Party also described himself as a " Socialist ". Is it likely that they both meant the same thing? Or is it more likely that, in this connection, they were in fact speaking different languages?

Do Prohibitionists and Anti-Prohibitionists mean precisely the same thing when they use the word " *Liberty* "?

Are we sure that we all mean the same thing when we speak of an " *educated man* "? Or of " *God* "? Or of a " *democrat* "? Or of " *capital* "? Or of " *instinct* "? Or of an action being " *right* "?

There are hundreds of words like these—words in everyday use—in regard to which we cannot be sure (unless we have made sure) that we ourselves are speaking the same language.

* * * * *

The great majority of arguments and discussions in everyday life are utterly futile—sheer waste of time and

temper—hopeless from the start . . . simply because the parties are using the same words, but using them in different senses. They are speaking different languages, and they do not recognize the fact. They would have a better chance of convincing each other if one were speaking Russian and the other Portuguese—for then at least they would recognize the necessity of calling in an interpreter.

Therefore I urge you never to take part in any argument at all—on any subject—with anyone—*unless* you have first made quite sure that both parties are *using the words in the same sense.*

Try it during the coming week. You will find the practice so illuminating and so useful that you will probably carry on with it all the rest of your life! Just test it when you are in conversation with anybody: ask him what *he* means by some term that you find yourselves using. Find out whether you and the other man are really using that term in the same sense: *i.e.* speaking the same language.

* * * * *

Exercise in Definition.

Set out in other words—as clearly and concisely as you can—what you mean by each of the following terms. Then take opportunities of asking your friends what *they* mean by these same terms.

(*a*) Socialism.
(*b*) Instinct.
(*c*) Education.
(*d*) God.
(*e*) Progress (social).
(*f*) Democracy.
(*g*) Moral Courage.
(*h*) Conscience.
(*i*) Internationalism.
(*j*) A "right to live".

Make a list of several other words which are commonly used by different persons in different senses—resulting in much confusion and misunderstanding in argument.

UNFINISHED TERMS

A great deal of vague and confused thinking occurs as a result of our using certain nouns and adjectives which we may call "unfinished". Examples are: "Unfit", "Desirable", "Good", "Beautiful", "Progressive", "Dangerous", "Valuable", etc. *In order to make their meaning clear and certain, we have to ask: Unfit—for what? Progressive—towards what? Valuable—to whom? Good—for whom? Or good—for what? Beautiful—to whom?* . . . And so on.

Examples:—

(*a*) "The value of a commodity consists in the quantity of labour which would be required for its reproduction" (Karl Marx). Its value—*to whom*? To the producer? To the prospective customer? To me?

(*b*) "One of the results of the child-welfare system must be to preserve numbers of unfit children who would otherwise perish." Unfit—*for what*? To grow up without the aid of the system? Or, having grown up with its aid, to be useful citizens in after life?

(*c*) "Honesty is the best policy." Best *for whom*? For the honest person? Or for those who have dealings with him? Or for the community?

(*d*) "Such-and-such scenery (or music, or poetry, or architecture) is beautiful." Beautiful—*to whom*? To you? To me? To the Chinese? To the West African negro? To the Mid-Victorians? To John Ruskin? To the classic Greeks? To the younger generation? "Beauty" is always an incomplete term; and much confused thinking results from the neglect to complete it.

(*e*) "The progressive policy of a political party." Progressive—in what direction? Forward, of course—but which direction is forward? Towards what objective? The same word, "progressive", is often used by persons who wish to move in exactly opposite directions. Progressive, then—*towards what*?

(*f*) "It is dangerous for young people to question the beliefs handed down to them by their forefathers." Dangerous—*to whom*? And the danger which is referred to—danger *of what*?

(*g*) "A revival of the custom of regular Bible-reading is very desirable." Desirable—*to whom*? Who desires it? Is this anything more than a bare statement that the speaker himself desires it? Yet the use of the unfinished expression, "desirable", is apt to impress people more than the straightforward statement, "*I* desire it".

(*h*) "Is democracy better than dictatorship?" "Is freedom better than discipline?" "Is work better than leisure?" Better—for whom? And better—in what respect?

The foregoing examples are given not merely for the reader to complete for himself the incomplete terms. To do that, and leave it at that, would be to miss the point. We need to recognize that *the use of any such incomplete term is likely to result in confused thinking, misunderstanding, and often the fatal fallacy of "begging the question". Therefore we should be always—always—on the look-out for these incomplete terms; and we should always insist upon having them completed.* This we shall find a very powerful aid to clearer thinking.

"COLOURED" TERMS

There are other terms which do not only embody some meaning about the quality or thing referred to—about the quality or thing itself—but also suggest our own personal attitude towards it. These may be known as "coloured" terms; and they are dangerous unless clearly recognized. The implication is that we regard the object with either favour or disfavour. But it is easy to forget that the choice of such word signifies only that we personally like or dislike the object. *The use of this term—which really signifies*

only our own personal approval or disapproval—may easily lead to the error of supposing that there is some intrinsic goodness (or badness) in the thing itself.

Consider the following passage. "We can admit that the British are a *reserved*, somewhat *unemotional*, very *persevering* people, with a marked strain of *puritanism*. Such at any rate is the verdict of our foreign friends. Our enemies might prefer the terms, *secretive, cold, pigheaded*, and *pharisaical*. But the fundamental qualities are the same in either case." It is worth comparing these pairs of opposite-coloured terms.

Similarly, if we approve of the quality referred to, we usually speak of "*humanitarianism*"; but if we disapprove, we call it "*squeamishness*" and "*maudlin sentimentality*". If we approve of another quality, we call it "*respect for law and order*"; while if we despise it, we call it "*tameness*". If we approve of our form of government, we speak of "*democracy*"; while if we disapprove of it, we call it "*mob-rule*". The unfinished term, "*progressive policy*", is also a coloured term: it means usually nothing more than that the person using the term approves of the policy referred to.

The word "*good*" often means no more than that the speaker personally approves of something—though, of course, it ceases to be a coloured term if we are judging by some definite and objective standard. In England, "*Tory*" is often used as a coloured term implying dislike of the Conservative Party; and the word "*Colonial*" is used often as a

term implying a certain degree of patronizing contempt. "*Statesman*" and "*Politician*" are sometimes used as opposite coloured terms. "*Atheist*" is used as a term to imply hostility. "*Sect*" and "*Sectarian*" usually imply mild contempt or disapproval.

"*Faith*" and "*Credulity*" are used to imply respectively approval and disapproval; both terms may refer to exactly the same quality, but it can be called by either name according to whether the intention is to praise or disparage it. Similarly with "*Miracle*" and "*Magic*". "*Conscription*" is tinged with the colour of disapproval, while "*Compulsory Service*" implies some degree of approval. "*Troops*" and "*Soldiery*" are opposite-coloured terms; and so, likewise, are "*the people*" and "*the populace*".

We should always be on the look-out for such coloured terms, and recognize at once that their use indicates the personal approval or disapproval of the person who uses them—rather than any intrinsic goodness or badness in the thing itself.

ABSTRACT TERMS

An abstract term is the name of some QUALITY, STATE, or CONDITION of a thing; or some ACTION or PROCESS; or some RELATION between things. For example: "Length", "Poverty", "Courage", "Love", "Beauty", "Life", "Thought", "Pain",

" Memory ", " Intelligence ", " Will ", " Consciousness ", " Personality ", " Health ", " Evolution ".

If the reader will work through the examples given above, he will recognize that not one of them denotes anything that can be said to *exist*—that is, to exist except in the sense that it is a quality, state, process, etc., *of something*. It is very important to recognize this; for a great deal of muddled thinking results from the misunderstanding of abstract terms as though they denoted actually existing things. (It may be true that " things " themselves are only compounds of qualities, states, processes, and relations. Nevertheless, if the word " existence " is to have any meaning, these compounds—things—exist.) But qualities, states, processes, and relations cannot have any existence at all apart from the things *of which* they are qualities, states, processes, or relations. They are said, not to " exist ", but to " subsist ".

We recall the story of the Cheshire Cat in the story " Alice in Wonderland ", the grinning cat which presently went away . . . and *left its grin behind*. This is a joke, because everybody recognizes at once that a grin is only a *state* of something. Similarly, we would never seriously suppose it possible that a volcanic " eruption " could continue—without the volcano. But in regard to certain other abstractions, many people are confused. " Life ", for example, is only a *state* or *process* of something, the living thing. Then how shall life continue—apart from some body or thing which is alive? Surely " life " can no more exist by itself than the cat's

grin can exist apart from the cat. We might just as reasonably—or unreasonably—speak of a "fever" as "surviving" after the feverish body itself had been reduced to ash and soot in a crematorium.

Can "consciousness" continue after the death of the conscious person? It is a question which has interested men for ages. We will not attempt to discuss the question here; but it is useful to ask whether the term "consciousness" denotes something which exists in itself, or merely *a certain state of something*. The same questions may be applied to "intelligence" and "personality".

Further, we should recognize that any state or quality, or any action or process, can *commence* and *cease*. It is a common error—fatal to clear thinking—to take an old principle of physics, like the indestructibility of matter or the conservation of energy, and apply it to states and qualities, actions, processes, or relations. There is certainly *no* "indestructibility" of qualities, states, processes, or relations.

Let us be careful always to recognize abstractions as such, and to guard against confusing qualities, states, processes, etc., with "things".

AMBIGUITY

Much confusion arises from the use of words and phrases which are ambiguous—words and phrases which have more than one meaning. Under the heading, "Speaking the Same Language", we have already referred to the danger of misunderstanding as a result of a speaker using a word in one sense, while his hearer takes that word as meaning something altogether different. The danger of confusion is almost as great, however, even in one's own private thinking. One may use the word first in one sense, and then, later in the same piece of reasoning, in another sense.

For instance, the term "*Free Trade*" may mean reciprocal trade between two countries and not subject to customs duty either way. An argument in favour of free trade (in that sense) may be propounded. Then the conclusion may be that free trade is desirable; but by this time the meaning of the term may have been changed, so that one supposes it to be proved desirable for trade in one direction to be "free" even though trade in the other direction is subject to import-duty.

As another example, one may commence to think about "*internationalism*" in the sense of friendly co-operation and a spirit of give-and-take among the States and nations of the world. But gradually, even while one is thinking about this subject, the meaning of the term may change; and presently one may be still using the same term, but now as signify-

ing that the individual's duty to mankind as a whole takes precedence over his duty to the particular nation to which he belongs.

* * * * *

A different kind of ambiguity occurs in such a statement as: "*I admire brown-eyed women*". At first glance, perhaps, this looks quite unmistakable. But suppose it is followed by another statement, "Jane is a brown-eyed woman". *Must* it follow that I admire Jane?

Let us re-cast the sentence. To express its meaning distinctly, should we say: "I admire all brown-eyed women"? If so, then it must necessarily follow that I admire Jane. Or should it be, "I admire brown eyes in women"? If this is the meaning intended, then perhaps I may not admire anything about Jane—except her eyes. It is clear that the original sentence was ambiguous.

* * * * *

Even the word "*same*" may mislead us. An old theological argument ran as follows.

> If I saw a certain man yesterday, and to-day I again see the same man, then I must believe that, although not visible to me in the meantime, yet he must have existed somewhere. The fact that I was not aware of him does not mean that he ceased to exist. That I now recognize him as the "same" man proves that he must have been in existence all the time, even when I did not see him. Similarly, if I had a certain idea yesterday, and to-day I again have the

same idea, then, although this idea has not been present in my mind in the meantime, it must have existed somewhere. Otherwise—without continuity of existence—it could not be the "same" idea. But where can that idea have been during the time when it was not in my mind? There must be some General Mind (God) where all thoughts or ideas continue to exist when they are not in any individual mind. This proves (it was alleged) the existence of God.

The fallacy lies, of course, in the double use of the word "same". In the first case it means *identically* the same man. In the second, it means an *exactly similar* thought, but not identically the same one—or the "same" only in the sense in which one may speak of oneself as whistling the "same" tune every morning.

It is worth thinking out the difference between seeing the "*same*" *man* as before, and whistling the "*same*" *tune* as before.

* * * * *

The word "*law*", likewise, may lead to confused thinking unless we recognize that it may be used in at least two different senses. A law of the State is mandatory: it is a command that such-and-such an action shall be done (or not done). On the other hand, a law of Nature is merely a statement of the fact that man has discovered that, in given circumstances, such-and-such an event always happens. In the first case, the "law" is a command that something *shall* be done; in the second case, it is a state-

ment that something *is* done. Thus it is impossible to "break" a law of Nature. The point is worth considering so that we shall recognize the need for care in using ambiguous terms.

* * * * *

"Good literature should be read in schools. Therefore the Bible, being good literature, should be read in schools."

This introduces us to a new type of danger. Do we mean that *all* good literature should be read—all the good literature that exists? Or only some of it? The argument, as given, is perfectly valid if we mean "all" good literature; but otherwise it is invalid. More will be said of this type of reasoning, later.

"Alcoholic drink causes misery."

Does this mean that *all* alcoholic drink causes misery—or only some? Then, if it be further argued that, because it causes misery, alcoholic drink should be prohibited—does this mean that it should *all* be prohibited because *some* of it causes misery? To make sure of such points is essential as a preliminary to clear thinking.

Let us, then, in thought and argument, adopt the practice of inserting such words as "all", "every", "always", "only", "some", or "sometimes", wherever this is necessary to make the meaning of a statement (or argument) more definite and distinct.

BEGGING THE QUESTION

Here are two other kinds of confused thinking which are very common. The first consists of *an argument in which the 'reasons' and the 'conclusion' are almost identical—but merely stated in different words.* For instance, it was once solemnly explained that the reason why a certain drug tended to make a person sleepy was "because it had soporific qualities". Expressed plainly, the explanation (?) was that this drug caused sleepiness because it was a thing which caused sleepiness. Of course, that is a simple and obvious example of the kind of reasoning in question. Usually such arguments are wrapped up in many words, rendering it difficult to 'spot' their real nature. But it is interesting and useful to look out for instances of the fallacy—say, in the leading articles of our newspapers.

Consider the following argument (quoted by Whatley):

> "To allow every man an unbounded freedom of speech must always be, on the whole, advantageous to the State; for it is highly conducive to the interests of the community that each individual may enjoy a liberty perfectly unlimited in expressing his sentiments."

Again, consider this argument.

> "It is degrading to a man to live on a dole or any payment made to him without his being required to render some service in return. The reason is that he thus becomes, from an economic

standpoint, a parasite upon the community as a whole, a position which is inconsistent with the maintenance of an individual's self-respect."

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ARGUING IN A CIRCLE is rather similar. For instance, it may be argued that :

"The existence of a personal God is proved by the Bible; and the authority of the Bible must, of course, be accepted because it was inspired by God."

Another specimen argument may be considered.

"The Government should not attempt to regulate or control the industries of the country because such a function does not properly fall within the sphere of governmental activities."

A final example of arguing in a circle :

"An indication of the reduced prosperity of the nations is found in the statistics revealing the decrease of international trade. Any increase of internal production for internal consumption is irrelevant from this standpoint; because the only part of production which conduces to the prosperity of the people as a whole, is that part which is exchanged for the products of other nations and thus is registered by international trade statistics."

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Another form of "begging the question" is to put a question such as: *Why* is so-and-so the case?—without first showing that it is the case. For instance :

"Why does worry turn the hair grey?"

" Why is it more degrading to a person to live on a Government dole than to live on interest on Government bonds? "

" Why is cigarette-smoking more injurious than pipe-smoking? "

" Why do you not follow the nobler course of declaring yourself a pacifist regardless of the circumstances in which a war breaks out? "

" Have you left off beating your wife? Answer yes or no."

" At what precise point in history did the divine inspiration of speakers and writers cease? "

RE-STATEMENT IN " CHECK FORM "

Before we start to test the truth of any statement—or the validity of any piece of reasoning—*we must make quite sure that we have grasped its exact meaning. The best way to do this is to put the statement (or argument) into different words.*

If there is any ambiguity in the original passage (which does not appear on the surface), we shall probably discover it as soon as we come to re-state the meaning in other words. It is astonishing how many different senses there are in which an apparently plain statement can be understood.

In re-stating the argument, we must, of course, be scrupulously careful to preserve its precise meaning. Our purpose is to make that meaning perfectly clear and certain—not to vary it even in the slightest degree.

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Most speakers and writers use far too many words. They obscure their thought with great masses of verbiage. Usually it is possible to re-write a passage—expressing every essential point with clarity and precision—in one-half, one-third, or one-quarter of the number of words.

In most cases, the first thing to do with any passage we wish to examine critically is—to BOIL IT DOWN. Boil it down! Pick out the essential points. Express them in the clearest, simplest, most direct language. Eliminate all decorative frills—everything that is not vital. Use short, straightforward sentences. Arrange the ideas in proper sequence, so that thought advances step by step, each step leading to the next—from starting-point to conclusion.

(The art of précis-writing is, unfortunately, much neglected in modern education. Perhaps some day we shall be sensible enough to give it an important place in every school and university syllabus. In the meantime, a person who wishes to increase his mental power—enormously—can spend a daily half-hour in no way more profitable than in précis-writing.)

How is it that so many irrelevant arguments; so many crude fallacies; so many instances of "reasoning in a circle"; so many assertions made without

the slightest real foundation—how is it that so many of them avoid exposure? How is it that they are not recognized, at first glance? Undoubtedly it is because, in most cases, they are wrapped up in so many words—so involved—so obscurely expressed.

Therefore I say that, for critical examination, we should form the habit of BOILING DOWN every statement and every argument to its BARE ESSENTIALS—expressed in the clearest, simplest, most straightforward terms.

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This may be called putting a statement or argument into "*check form*"—the form in which it can be most effectively checked and tested. The following suggestions should be followed.

(1) Pick out all the essential points.

(2) Express them in the clearest and simplest language, in a succession of short, direct sentences.

(3) Arrange the arguments in proper order, leading from starting-point to conclusion.

(4) Define any vague, doubtful, or ambiguous terms.

(5) Spot any "unfinished" terms—and make their meanings clear by completing them.

(6) Spot any "coloured" terms, which really signify only the approval or disapproval of the writer, but which tend to suggest some goodness or badness in the object itself—without any attempt to prove it. Counter-

balance each coloured term by bracketing it with a corresponding term of the opposite colour.

(7) Notice what abstract terms occur—and be careful to avoid treating them as concrete terms.

(8) Wherever required, in order to make the meaning clear and definite, insert such a word as "all", "every", "nearly all", "most", "a few", "no", "only", "always", "sometimes", "never".

(9) Observe if the writer is guilty of begging the question, or arguing in a circle.

The passage, thus converted into check-form, is now ready for examination to ascertain—(*a*) if the "facts" are well-founded and accurately stated; and (*b*) if the inference or reasoning is valid.

SECTION II

GROUNDLESS BELIEFS

In future we are going to follow the practice—until it becomes a habit (' second nature ')—of classifying propositions according to their grounds. Of every statement we come across, we shall ask : " HOW DO WE KNOW THAT? WHAT REASON HAVE WE FOR BELIEVING THAT? ON WHAT ' GROUNDS ' IS THAT STATEMENT BASED? " Probably we shall be astonished at the number of propositions met with in everyday life—propositions usually accepted blindly, without question, as a matter of course—which we shall find it necessary to class as groundless. They rest upon mere tradition, or on somebody's bare assertion unsupported by even a shadow of proof.

Indeed, if we examine even our *own* beliefs critically, we are sure to find that many of them have no real ' grounds ' at all. Somebody once told us that a certain thing was true. Or we may, somehow, sometime, have ' picked up ' the idea and never even thought of questioning it : we may have " taken it for granted ", merely assuming its truth.

If any belief is classified under one of the headings set out in this book, and when tested fails to satisfy the tests—then we have no justification in reason for continuing to hold it.

If we find ourselves still holding it in spite of its failure, we must conclude that we hold it only upon non-rational grounds.

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It may be a belief which we originally accepted as a result of simple " suggestion ", and we have continued to hold it ever since. It has now become one of our regular habits of thought. *Perhaps somebody—somewhere—sometime—told us a certain thing, and quite uncritically we accepted and believed it. Perhaps it was away back in our early childhood—before we had even developed the power of questioning anything that might be told to us.* Many of our strongest convictions were established then; and now, in adult life, we find it most difficult even to question their truth. They seem to us " obviously " true: we feel that even to question them would be " absurd ".

But if the staunchest Roman Catholic and the staunchest Presbyterian had been exchanged when infants, and if they had been brought up with home and all other influences reversed, we can have very little doubt what the result would have been. It is consistent with all our knowledge of psychology to conclude that each would have grown up holding exactly the opposite beliefs to those he holds now . . . and each would then have felt as sure of the truth of his opinion as he now feels—of the truth of the opposite opinion. The same thing is true, of course, of many beliefs other than those of a religious nature. If we had grown up in a community where polygamy, or head-hunting, or infanticide, or gladiatorial fighting, or duelling, was regarded as the normal and natural

thing—then we should have grown up to regard it as "obviously" natural and perfectly moral and proper. If we had been bred by criminals amongst criminals in one of those quarters of a great city where criminals dwell—then we should have grown up with a set of moral standards quite different from those we have. Or if an English baby had been adopted and brought up in a German home, and had grown up with no knowledge that his parents were English, all the sentiments and beliefs of that person would be "German" and not "English". Many of our beliefs—many of our most deeply-rooted and fundamental convictions—are held simply as a result of the fact that we happen to have been "brought up" to them.

Of course we do not cease, when we cease to be children, to adopt new beliefs on mere suggestion. We continue doing it, more or less unconsciously, all our lives: hence, to take only the most striking examples, the enormous influence of newspapers and the effectiveness of skilful advertising. *Much of what passes as such is not, strictly, thinking at all. It is the mere "parroting" of ideas picked up by chance and adopted as our own without question. Most people, most of the time, are mere parrots.* But as we leave childhood, we tend to accept only such new ideas as fit in with the ideas we already hold; and all conflicting ideas seem to us "obviously" absurd.

Propositions that are accepted simply because "everybody says so", must be classed under the same heading. The dogma may not be that of any particular individual: it may be a dogmatic state-

ment which has been passed from one person to another, from generation to generation, perhaps for hundreds—perhaps for thousands—of years. It may be part of the traditional belief of the people or the race. In that case, it is part of our social inheritance from some period in the past. But we should fully face the fact (already stated) that beliefs which are merely inherited from the past must have originated at a time when men knew much less than they know to-day. So the fact that a belief is 'old' is no argument in its favour.

We need especially to be on our guard when we come across propositions which seem to be "obviously" true—so obviously that it seems impossible to doubt them.

> "When we find ourselves entertaining an opinion about which there is a feeling that *even to enquire into it* would be *absurd, unnecessary, undesirable,* or *wicked*—we may know that that opinion is a non-rational one." (TROTTER.)

When we are tempted to say that any general truth is so "obvious" that it would be absurd even to question it, we should remember that the whole history of the development of human thought has been full of cases of such "obvious truths" breaking down when examined in the light of increasing knowledge and reason. For instance, for ages nothing could have seemed more obvious, more utterly beyond question, than the proposition that slavery was natural, reasonable, necessary, and right. Some kinds of men were "obviously" "slaves by nature". To doubt it was impossible.

Again, for more than two thousand years it was "impossible to conceive" the planets as moving in paths other than circles. The circle was "obviously" the perfect figure; and so it was "natural" and "inevitable" to suppose that the planets moved in circles. The age-long struggle of the greatest intellects in the world to shake off that assumption is one of the marvels of history.

It was formerly "obvious" that the heart—and not the brain—was the organ of consciousness. To most people to-day (even apart from proof) it seems equally "obvious" that we think with our brains. Many modern persons find it very difficult to credit the fact that men can ever have supposed otherwise. Yet—they did. And, what is more, the "truth" that we think with our hearts seemed to them so "obvious" that it was absolutely impossible for them to doubt it.

That the earth must be flat, formerly seemed so obvious and self-evident that the very suggestion of any other possibility would have been—and was—regarded as a joke.

It was for two thousand years "taken for granted" as "obvious" that a heavy weight must fall faster than a light one. An assumed or dogmatic proposition which had been universally accepted as "obvious"; and which, when challenged, was supported by reference to a dogma of Aristotle. Until Galileo actually demonstrated the contrary, nothing could have seemed more beyond possibility of doubt.

Propositions which are accepted blindly, without question, on the grounds of mere assumption or dogma, need to be frankly recognized as such. Progress in human thought seems to consist mainly in getting rid of such ideas.

* * * * *

Other beliefs are held through self-interest. Modern psychology leaves us no room for doubt on this point. We adopt and cling to some beliefs because—or partly because—it 'pays' us to do so. But, as a rule, the person concerned is about the last person in the world to be able to recognize this in himself. Indeed, he would probably be highly indignant if told of what anyone familiar with modern psychology can recognize so plainly. It would be quite wrong to attribute all opinions—even political opinions—to self-interest. But it would be equally wrong to deny that this is one potent factor.

'Self-interest' is to be understood first in the ordinary sense, as referring to a man's way of earning his livelihood and acquiring wealth. But we may extend the term to cover also his interest in social position; popularity with his fellows (at least his own 'set'); the respect and goodwill of those whose respect and goodwill he values; agreeable associations with the people of a particular party, church, or social set, from which he would be excluded if his opinions were changed. It covers his interest in his own career; in whatever prestige he enjoys as one of the leaders—or at least as a valued supporter—of some movement or institution, some political party, some religious body, some other kind of society or group. There is

many a man who is unconsciously compelled to cling to a belief because he is a "somebody" in some circle—and if he were to abandon that belief, he would find himself nobody at all.

Putting it broadly, we should always suspect any of our opinions when we recognize that our happiness depends, directly or indirectly, upon our continuing to hold them—when we might lose anything, material or otherwise, by changing our opinion.

Somewhat similar is the acceptance of an opinion through the desire—probably not recognized by the person concerned—to justify his own nature, his own position, or his own behaviour. The coward can so easily adopt a philosophy which seems to justify cowardice—though, of course, "cowardice" is not the name he gives it! The lazy and bungling person can adopt a set of opinions which prove to his satisfaction that "the grapes are sour"—the "grapes" being the rewards that more energetic and competent men can win. And many a preacher and propagandist is like the fox that lost his tail. (There is much wisdom in Æsop!)

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Many groundless opinions are held through sentimental associations. The thought is associated with memories—pleasant or unpleasant as the case may be—of particular persons who held similar opinions. It is found that many a man who in childhood was hostile to his father, in after life is always prejudiced against whatever opinions his father used to express. And conversely in the case of one who has pleasant recol-

lections of his father, his mother, a teacher perhaps, or some other person who played a big part in his early life.

In adult life, as we have often observed, a bitter quarrel may change a man's opinion entirely. Antagonism to a man usually produces some antagonism to his opinions; and the bitterness felt against the man usually spreads to the idea for which he stands. What keen satisfaction we find in belittling the opinions, or attacking the opinions, of somebody of whom we are jealous, or of somebody against whom we bear a grudge! But, on the other hand, it is equally true that friendly feelings to a man have an effect in disposing us to feel friendly to his views.

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Other opinions again are determined by what we may best call Fashion. To take one example: how largely our opinions on the merits of certain authors, or poets, or composers, are dictated merely by fashion! But the effect of fashion is very much wider than that: we trace it almost everywhere, in every field of thought. *We tend very strongly to feel and to believe as others are feeling and believing. Not all others, perhaps; but others of our own set.*

But we do not, as a rule, continue all our lives changing our sentiments and opinions with every change of fashion. Sooner or later our minds become fixed. Many a man holds his opinions to-day—because they happened to be in fashion ten, twenty, thirty, forty, or fifty years ago.

Once an opinion is accepted, whatever be the cause of its acceptance, it has a strong tendency to persist. Every time we think along a particular thought-pattern, makes it easier for us to think the same way again. It is quite legitimate to speak of "habits" of thought. The "brain path" becomes so well worn; the pattern of brain-centres becomes so well connected up by continual use, that the nerve current finds a route of practically no resistance, and so it always takes almost exactly the same course.

We all know the person who has a string of stock anecdotes. We all know too the person who has certain stock arguments and opinions which he expresses, almost in the same words, whenever he receives the 'cue'. We all know men and women whose minds work like gramophones. Put them on to the 'record' about the good old days; or about prohibition; or about the wicked capitalists; or about the lazy and improvident workers; or about their illnesses (the tale of their troubles and the number of operations they have undergone); or about some holiday they once spent; or about the country going to the dogs; or about the modern girl; or some long, tedious anecdote about what I said to him, and what he said to me, and I said . . . and he said . . . *and then I told him straight. . . .*! All we have to do is to start him off—and nothing on earth can stop him—until the 'record' has run out!

The same thing is true of opinions and beliefs of all kinds. After they have been held a certain length of time, they become, as it were, so stamped in by continual

use that it is almost impossible now to change them. While we are young, we are continually taking in new ideas, altering our thought-patterns, "making up our minds" afresh. As we grow older, we become less and less able to accept any new idea which will not fit in with our existing thought-pattern. Thus we become, in James's term, Old Fogeys. Sometimes our thought-patterns set while we are still quite young. In a few rare cases they remain open or alterable even into old age. An Old Fogey may have become such at seventeen—or seventy. We are Old Fogeys from the moment when we become unable to accept any new fact, any new idea, which would necessitate changing our established habits of thought. "I am almost afraid to say so (says James), but I believe that in the majority of human beings Old Fogeyism begins at about the age of twenty-five."

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Yet when full allowance has been made for all these non-rational factors in the determination of opinion, there remains—not in all minds, not in most minds, but in some—a desire to discover the facts; to think things out in a clear and rational way; to get at the truth at all costs, whatever it may turn out to be! For such minds this book is written.

SECTION III

WHAT MAY WE BELIEVE?

ON WHAT GROUNDS?

THERE is one question which is probably more useful than any other to a person who wishes to cultivate the power and habit of Clear Thinking. It is:

WHAT GROUNDS HAVE YOU
FOR BELIEVING THAT?

or

WHAT GROUNDS HAVE I
FOR BELIEVING IT?

* * * * *

One soon comes to realize that a majority of people hold the majority of their beliefs without having any adequate grounds for them. They have no 'reason' for believing what they do: they cannot give any evidence to support their ideas. If you ask them, "*Why* do you think that?"—or, "What is your *reason* for believing it?"—they cannot reply. Perhaps they will be taken aback by the question. Perhaps they will begin to bluff and bluster. Perhaps they will be annoyed. Or perhaps they will put forward some sort of "reason" which you can recognize at once as wholly inadequate or illogical.

In Section II of this book we have glanced at some of the most common explanations of people holding ideas, beliefs, without having any real grounds for them. People of low critical intelligence, people with hazy or sluggish minds, people who do not really think—mostly, they believe whatever they have been *told* . . . provided that it does not conflict with their established habits. (I mean, of course, not physical habits, but their habit of believing certain things.)

But others—those with active and intelligent minds, people who *think*—always they try to ensure that their beliefs are well-founded, and that their ideas on every subject are rational and sound. Any idea which does not satisfy the tests of reason, they reject. Any idea which does comply with the conditions of sound judgment, they are prepared to accept—even though this may necessitate a complete reconstruction of the opinions they have hitherto held.

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How do you know? Can you prove that? What is the evidence? Have you tested your grounds for believing it?

These are the questions to ask—continually. They should be put to other people, tactfully if possible. But the most important thing is that one shall be continually putting these questions to *oneself.*

And another question! Whenever we have satisfied ourselves that such and such a thing is so—a fact—we should then ask next: "*What is the explanation of it?*"

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The rest of this book will be devoted to an outline of the various 'grounds' on which ideas, opinions, and beliefs may be held. Our purpose is to give the reader a means of testing and judging for himself (on every question where he possesses the necessary information) whether or not there are adequate grounds to justify him in holding a particular opinion or belief.

Opinions and beliefs may be accepted as true as a result of:

(*a*) The judgment of others; or
(*b*) One's own judgment.

In the next few pages, we shall outline the conditions under which one is rationally justified in holding an opinion or belief, *without* having studied the question and reached one's own conclusions, but on the strength of the judgment of some other person who has done so. After this has been dealt with, we shall turn to the question of thinking things out for ourselves—forming our own opinions—and testing them.

ACCEPTING THE JUDGMENT OF OTHERS

Can we ever be justified in reason in accepting the judgment of another—without ourselves having verified the facts and tested the reasoning upon which his judgment is based?

Certainly we can—and must—do much of our investigation and reasoning by proxy. It is not a repudiation of reason. It is merely allowing somebody else (in whose ability we have reasoned confidence) to do some of our reasoning for us.

There was a time, no doubt, when practically all that was known could be known to all men—or, at any rate, to all who cared to learn. There was a time when an intelligent and well-informed man could form a reasoned opinion for himself on almost every question. But that time has passed. To-day it is absolutely impossible for any man—*any* man!—to know a thousandth part, or a millionth part, of all that is now known. Therefore there must be very many subjects upon which it would be impossible for us personally to form for ourselves an intelligent opinion—because we do not know the facts.

To-day, to become acquainted with all that is already known, even in one limited field of knowledge, requires a lifetime of study. If we personally wished to verify the facts and the reasoning of astronomers and mathematicians about the structure of the Universe, we should need to devote almost our whole lives to that. But even if we did that, we should still have to accept "on the judgment of others" the great majority of the facts and the conclusions of the historians. And the facts and findings of the geologists. And of the physicists. And of the biologists. And of the psychologists. And of the economists. And of the anthropologists. And of the translators of books written in other languages. And of experts in foreign affairs. And of students of

the Mohammedan religion; Maori lore; the mentality of the Japanese; the relation of diet to health; and the best treatment for tuberculosis. And we must usually depend upon the information and the reasoned opinion of someone else to tell us the application of the law of the land to particular cases. And what type of lenses are needed to help our eyesight. And how various religious beliefs evolved and came to be accepted. And whether or not a particular industry is economically sound and efficient. And so on.

* * * * *

One of the most pitiable sights imaginable is that of a person who is blissfully ignorant of the vast accumulation of existing knowledge on some question, and blissfully ignorant of the immense amount of painstaking research and reasoning that has been done—to see him, equipped perhaps with five out of the five hundred thousand known facts, "having a shot" at "thinking things out for himself." And the *fewer* facts he possesses, the *simpler* the problem seems to him. If we know only a dozen facts, it is not difficult to find a theory to fit them. But suppose there are five hundred thousand other facts known—but not known to us! Of what value then is our poor little theory which has been designed to fit, and which perhaps fits, only about a dozen of the five hundred thousand known facts!

In many cases, too, we must recognize that the work requires a specially-trained mind, and a mind with a special ability and long experience in dealing with some particular kind of material and reasoning.

We see this—to take only a few examples—in research in the physical sciences; in dealing with the facts which form the subject-matter of psychology; in historical criticism; in mathematical calculations; in the interpretation of the law; in weighing the evidence of evolution.

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Obviously, under these conditions, we ought *not* to accept *just anybody's* judgment. And we cannot in reason accept any mere dogma. We want a *rational* judgment; for we are not failing to recognize the importance of verified facts and logical reasoning. On the contrary, it is our very recognition of this which impels us to delegate our reasoning to someone who, on this particular subject, is more competent than we are to verify the facts, test the reasoning, and reach a valid conclusion.

But it is reasonable to accept the judgment only of someone in whom we have, not blind, but reasoned, confidence.

We are not going personally to test the facts and reasoning upon which his judgment is based. Yet there must be some tests. *We shall not test the judgment; but we must test the judge. Unless he satisfies the tests, we are not justified in reason in accepting his judgment.* And unless we can find a judge who satisfies all the tests, there remain but two alternatives for us—either to keep an open mind on the question; or else to judge for ourselves.

JUDGMENT OF THE RECOGNIZED EXPERT AUTHORITIES

All four of the following conditions must be complied with to justify us in accepting a judgment under this heading. The expert authorities concerned (or at least their representative or spokesman who is quoted) must be—

(1) *IDENTIFIED. It is not enough to claim that "a German professor says so-and-so"; or that "doctors say . . . "; or that "history teaches us . . . "* We must know exactly who it is whose judgment is to be accepted.

(2) *RECOGNIZED. That is, recognized as an expert authority on that particular subject; and recognized by his peers and co-workers in that field.* There are many "sham authorities"—recognized, for example, by the press, or by some following of laymen. But these are not in a position to judge a man's standing: only his co-workers and advanced students can do that. It is essential that the authority cited shall be a recognized authority on the particular subject in question. The bare fact that a man is a famous scientist in physics, does not give him any standing to pronounce on, say, allegedly "spiritualistic" phenomena. Similarly, the fact that a successful man is recognized as an authority

on business, does not give him any standing in religion, politics, or foreign affairs.

(3) *LIVING. We may, however, accept the judgment of a dead authority if—but only if—we are sure that no fresh facts or arguments can have come to light since his death. This condition can rarely be satisfied; so normally we are bound to confine ourselves to living authorities.* It is useless, for example, to quote any scientist or historian of the last century as an expert authority now. His evidence and reasoning may be very valuable; but we are not justified in accepting it "on authority" unless it is confirmed and vouched for by the living authorities. They alone can review the matter in the light of whatever fresh facts are now available. It is only the confirmation of a living expert authority which justifies us in accepting the judgment of an earlier one.

(4) *UNBIASSED.* This is a hard condition. We can never be sure that it is fulfilled in any case where the finding can affect the material interests, the prestige, the popularity, the sentiments, or the happiness of the authority concerned. Fortunately, however, there is an alternative. *For if there is AGREEMENT among most of the expert authorities, then we may assume that their various interests and prejudices cancel out, leaving us with a disinterested and unbiassed "composite authority" whose judgment may be accepted.*

To summarize: the four conditions are that the expert authority must be—

Identified.
Recognized . . . in that subject.
Living (as a rule).
Unbiassed—or virtually unanimous.

If any one of the foregoing conditions is not satisfied, the statement cannot be accepted as resting on "recognized expert authority".

JUDGMENT OF SOMEONE IN WHOM WE PERSONALLY HAVE CONFIDENCE (HE NOT BEING ONE WHO SATISFIES THE TESTS TO MAKE HIM A RECOGNIZED EXPERT AUTHORITY)

With most of us there are many questions upon which we are unable to form any rational and reliable judgment of our own; and yet we may not know, or may not be in a position to consult, the recognized expert authorities. In such case we may still be justified in forming a judgment (as it were) by proxy, adopting as our own the conclusions reached by somebody else. As before, this does not mean that we fail to recognize the importance of verified facts and logical reasoning. On the contrary, it is still our very recognition of this which impels us to delegate our reasoning to some other person—someone who is, we believe, on this particular question, able to form

a more reliable judgment than we could form for ourselves.

The recognized expert authorities are the same for all; and we have only to apply to certain persons the four clear-cut tests given on the preceding pages. But in the present case, where we are concerned with someone who is not a recognized expert authority (as defined), we are obliged to depend upon our own personal estimate of his qualities.

Only if three conditions are fulfilled are we justified in reason in accepting a belief on the judgment of another (he not being a recognized expert authority). These conditions are :—

(1) *CONFIDENCE. We must have confidence in his knowledge of the subject, and in his ability, rationality, impartiality, and honesty.*

(2) *REASONED CONFIDENCE. Our confidence must have some rational basis. That is, we must know him or know about him; and all we know about him must be consistent with our belief that he possesses the qualities stated in* (1). The more we know about him which is consistent with this, the greater confidence we can have.

(3) *SUFFICIENT CONFIDENCE. Our confidence must be sufficient to make us feel that we should be equally prepared to accept his judgment—even if it were the opposite of what it is.*

This is essential. For otherwise the position is, *not* that we accept the judgment because we

have confidence in the judge, but that we quote the judge only because his judgment happens to agree with our own belief. Our own belief does not, in that case, rest on his judgment at all.

We are not justified in reason in accepting the judgment of another unless all three conditions are satisfied. Special attention should be paid to the last condition, (3).

FACTS—KNOWN BY PERCEPTION AND BY INFERENCE

(NOTE.—Any metaphysical discussion would be out of place here. The reader wishing for an introduction to the problems involved, should begin by reading Bertrand Russell's "Problems of Philosophy", published in the Home University series by Williams and Norgate.")

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What is "truth"? A belief is true if—and only if—it corresponds to fact.

What is "fact"? Fact is that which IS—independently of our perception and belief.

These definitions do not raise the question of the nature of Ultimate Reality. Nor even do they beg the question of the existence, as an ultimate reality, of "matter". It suffices to say that there is 'something' —something which is directly known to us only as what are called sense-data: in other words, sights,

sounds, etc., which we perceive by our senses. This 'something', considering it as a whole, perhaps an infinite whole, is what we may term the Universe of Fact. Some parts of it—some fragments of it—are directly known to us through our senses. *Facts thus directly known (as sights, sounds, and so forth) may be called "PERCEIVED FACTS".*

But perceived facts are not the only facts we can know. Or, rather, *there are other facts which—though we cannot "know" them directly—yet we can "know of" them. We can know of them by inference. These may be termed "INFERRED FACTS".*

It is imperative to recognize, however, that the essential difference is not in the nature of the facts themselves. The difference lies only in our means of *knowing* or *knowing of* them. Facts are facts—whether we know them by direct perception, or whether we know of them by inference. Indeed, facts are still facts—even when we do not know them, or know of them, at all. To revert to our original definition: "Fact is that which *is*." Facts *are*—whether we know them or not. Our purpose is to *discover* them.

* * * * *

Nevertheless, for the sake of clear thinking, it is necessary to understand distinctly the difference between—

(*a*) Knowledge of facts by perception; and
(*b*) Knowledge of facts by inference (reasoning).

I can know water by direct perception of its appearance, its taste, its feel. If I examine a drop of water

through a microscope, I can know it better—still by direct perception. But only by inference can I know of the fact that each molecule of water is composed of two atoms of hydrogen and one of oxygen.

Indeed, by direct perception I cannot know even that water is useful for washing hands. What I *perceive* is only: dirty hands—application of water—clean hands. I must *infer* the facts of cause and effect.

Similarly, a detective investigating a murder *perceives* the room, the body, the wounds, and all the other data—some of which he can treat as clues to the identity of the murderer. But there are other facts which he does not perceive: he can discover them only by inference or reasoning. For instance, he must try to *infer* the fact of the murderer's identity; and he must try to *infer* how the deed was done.

Another illustration! We perceive in a book certain words attributed to Socrates, or Christ, or Napoleon, or Mussolini, or Roosevelt. We know by perception that the words are attributed to him. But we do not know by perception that he actually said those words. If it is indeed a fact that he said them, then it is a fact which we can know only by inference—not by direct observation.

Of course, if the person who tells the story claims personally to have been a direct witness, then it may be a perceived fact to *him*—though *we* still need to depend on our own reasoning to determine whether the evidence of the witness is reliable. More will be said

of this, later, under the heading " Observation and Evidence ".

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It is useful to reflect that, *if we were equipped with different senses, all that we now perceive would be unknowable to us by direct perception. But we should then be able to perceive (with those other senses) certain facts that now we can " know of " only by inference.*

For example, if our eyes were as powerful as microscopes, we should be able to see bacteria. But we could not then perceive elephants. We should be obliged to infer their existence.

Similarly, we now perceive the phenomena which, being of wave-lengths lying within certain limits, are registered by our sense of sight. There are millions of facts we *see*. Yet if our eyes were differently constructed, so that they were tuned to long wave-lengths instead of very short ones, then we should have direct sense-perceptions of wireless waves—which now we know only by inference—but we should then have no direct perception of all that part of the universe which is now visible to our eyes. We could only infer it.

This is an interesting subject for reflection.

BASIS OF REASONING

Of all the facts in the universe of fact, we can know some—relatively few—by sense-perception. But how can we come to know of others? By inference, or reasoning. *Inference or reasoning is a mode of thinking by which, starting from something known, we end by forming a belief that there exists a certain fact hitherto unknown.*

How can we be sure that there is any validity in this thought-process that we call "reasoning"? How can we be sure that the belief which we form by reasoning is true? How can we be sure that there really is a fact to correspond with our conclusion? Does it not all depend upon an assumption—the assumption that our methods of reasoning are valid?

The answer to this is that we do *begin* by simply assuming that our methods of reasoning are reliable, that they lead us to conclusions which correspond with facts. But many of our conclusions can be checked, verified, by sense-perception. Starting from facts known by sense-perception, we may reason to the conclusion that some other fact, though not yet perceived, exists. Then we look—and lo, there is the fact, a perceived fact now, identical with what our reasoning had led us to expect.

The same method of reasoning leads us to thousands of different conclusions which are afterwards confirmed by sense-perception: it enables us to make thousands of predictions as to what will happen in certain circum-

stances, and these predictions are then verified. Thus we gather confidence in our methods of reasoning, until at last we feel sure of our conclusions even when they are such as cannot be checked by sense-perception. We may thus be as sure of an inferred fact as we are of any perceived fact, provided that our original data are perceived facts; and provided that the method of reasoning is exactly the same as that which has led us to so many hundreds of thousands of conclusions already verified.

There are two fundamental assumptions in all reasoning. Or rather, they were originally assumptions. Now, as we have said, they are much more than assumptions; for they have led us to many hundreds of thousands of conclusions which have subsequently been confirmed by sense-perception. Every new verification of the results of reasoning increases the confidence which we can place in the reasoning-process; and thus it increases the probability of these two basic principles being true. They are now so highly probable that we can regard them as approximate certainties.

* * * * *

These two basic principles may be summed up in the single statement that *THE REASONING PROCESS IS VALID BECAUSE THE UNIVERSE OF FACT IS " RATIONAL ".* Or stating them separately, the two basic principles are :—

(1) *The universe of fact is a harmonious whole. All the facts of the universe are consistent with one another. Facts are never contradictory.*

(2) *The universe of fact is cosmos, not chaos. There is order, certainty, regularity, system, in the inter-relation of all the facts of the universe.*

This is not apparent when we are regarding only the perceived facts, amongst which there seems to be no order, no regularity, no system. But the perceived facts are only isolated fragments of the universe of fact—only patches of fact. All that we know by sense-perception is partial and patchy, meaningless when regarded by itself. It is only when we come to know more facts—many more than we can directly perceive—that we begin to discover among them the first signs of order, regularity, and system.

To take a simple illustration: we may perceive a bird, after striking a telephone wire, fall dead to the earth. We perceive that some muscular effort is required to raise a stone from the ground. We perceive the moon passing across the sky. We perceive that it is more tiring to walk uphill than downhill. A thousand perceptions, all apparently unrelated! Then an *inferred* fact is discovered—the so-called "law", or universal fact, of gravitation. Immediately all these perceived facts, together with this inferred fact, "fit together"; and so, for the first time, we are able to recognize order, regularity, system, among them all. The perceived facts, regarded by themselves, are irregular, unrelated, and chaotic. But the perceived facts and the inferred facts together make up a definite pattern.

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A fact is said to be "explained" when we are able to show how it fits into a system of facts; when we are able

to recognize it as part of a regular, orderly, inter-related whole.

Another way of saying that we have explained a fact is to say that we have discovered its " meaning ". Or we may say we explain it by discovering the cause and conditions of its existence. This all comes to the same thing: we have fitted this fact into a definite " pattern " of facts; we have recognized its necessary relationship to other facts; and we have ascertained that this particular fact is only an instance of some universal " law ", or part of the universal " order ".

WHAT IS TRUTH?

(1) *A true opinion, or a true belief, is one that corresponds to all the facts covered by it.*

(2) *All the facts of the universe are consistent with one another.*

(3) *It follows, therefore, that all true opinions and beliefs must likewise be consistent with one another.*

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If our opinions and beliefs were limited to *perceived* facts, no inference or reasoning would be necessary. Our beliefs would then be true if they were merely accurate and verified statements of what had been actually observed. Of course, many of our beliefs are of that nature. They take the form, simply, of Statements of Observation.

Thus, I believe that I have now a pen in my hand—a belief which corresponds directly to a perceived fact. I believe also that there are four electric light bulbs in this room, but only one of them is " on ". Both beliefs correspond to perceived facts; and they cannot therefore be inconsistent with each other. No reasoning is required, because all the facts which are covered by the statement are perceived facts.

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Inference or reasoning *is* required, however, when we wish to discover some new fact otherwise than by direct perception. As previously defined: Inference or reasoning is a mode of thinking by which, starting from something known, we reach the conclusion that there must exist also some other fact previously unknown.

If the reasoning is valid, then the new belief (which results from it) must correspond to all the facts covered by it. But we cannot verify this by observation. For instance, we may have direct observations to support the proposition that, " Of all the horned animals known, none are meat-eaters ". That is only a statement of perceived fact—and it can be verified by further observation.

But suppose, on the strength of this observation, we make an *inference*—that " *No* horned animals are meat-eaters ". Here is a statement which covers more facts than have been, or can be, known by sense-perception. It relates to *all* horned animals; and many of them have never been seen and studied. Therefore it is impossible to verify by observation the fact—if it is a fact—stated in this proposition.

Evidently, then, we cannot test the truth of every statement by seeing if it corresponds to all the facts covered by it.

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Now we come down to practical rules. When can we trust our inferences, even though we cannot verify the conclusion? What tests can we apply to our reasoning, to determine whether or not it is reliable—and if so, to what degree?

The governing principles are those stated in the previous section, under the heading "The Basis of Reasoning". *For practical application—to enable us to test the validity of any particular inference or reasoning —the following is a convenient form to use :—*

(1) *EVERY STATEMENT, TO BE WORTHY OF BELIEF, MUST DIRECTLY REFER TO, AND CORRESPOND TO, SOME KNOWN FACTS.* The more facts, and the more different kinds of fact, the better it is.

(2) *A TRUE STATEMENT CANNOT BE INCONSISTENT WITH ANY KNOWN FACT.* If there is inconsistency between the statement and *any* known fact, then the statement must be false. Note that "fact" includes any scientifically verified natural "law".

(3) *IF THERE IS INCONSISTENCY BETWEEN ANY TWO STATEMENTS, THEY CANNOT BOTH BE CONSISTENT WITH FACTS; AND THEREFORE AT LEAST ONE OF THEM MUST BE FALSE.*

SECTION IV

OBSERVATION AND EVIDENCE

OBSERVED FACTS

HITHERTO we have spoken of some facts as being known to us—or to others—by 'perception'. For practical purposes, however, it is better to speak of them as facts known by *observation*. This allows us to incorporate an element of recognition, differentiation, and very simple interpretation of what is perceived by the senses. In other words, there is in our observation, not only a pure sense-perception, but also a small amount of inference. It is important to understand this.

As John Stuart Mill says: "We may fancy that we see or hear what in reality we only infer. For instance, there is nothing of which we feel more directly conscious than the fact of the *distance* of an object from us. Yet what is perceived by the eye is nothing more than an object of a certain size and a certain shade of colour". We 'observe' that the object is at a certain distance from us, only by inference—making a rapid comparison (so rapid as to be unconscious) between the size and shade of colour of this object and of other objects seen at the same time—or of similar objects seen previously.

Again, when we see an orange a few yards away, it 'looks' spherical—even if we close one eye. It 'looks' spherical because we *already* know that oranges *are* spherical. But if the colouring were exactly the same, the object would still look spherical —even if it were only a piece of flat cardboard painted to resemble an orange and placed in the fruit dish.

As Mill further remarks, it is too much even to say, "I saw my brother" . . . unless we recognize that such a statement, a statement of observation, includes something more than pure sense-perception. For all that we *perceive*, strictly, is some object of a certain shape and colouring. We compare this—so quickly that we do it unconsciously—with memories of the appearance of our brother. Then it is only by comparison and inference that we interpret this new sense-perception and judge that we are looking at our brother.

Similarly, we cannot actually *see*, strictly, that the pavement is wet. What we know by pure sense-perception is only a darker colour than usual, or a shine, and perhaps a slipperiness—from which we *infer* the wetness of the pavement. It is possible that we are mistaken.

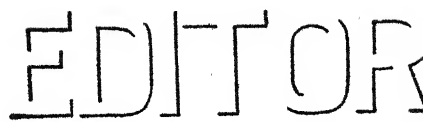
When we speak of an observation, therefore, we always mean something more than pure sense-perception. It is sense-perception plus recognition and some degree of interpretation. *The only question is: how much interpretation may be included in what we are entitled to call a "fact of observation"?* The

answer is that in every case it must depend upon the kind of enquiry or discussion in which we are engaged. *For ordinary, everyday purposes, we may admit as much interpretation as any man—not merely the person concerned, but any ordinary person—would feel was "safe".* Everything beyond that must be tested as an inference or a theory.

MISTAKES IN OBSERVATION

" Every impression that comes to us from without," says William James, " no sooner enters our consciousness than it is drafted off, making connection with what is already in our mind." *Every sense-perception falls into a mind already made up of memories, interests and expectations. The result is a new state of consciousness, of which part comes from the outer world and part (sometimes the larger part) is supplied by what is in the mind already.* The product is a sort of fusion of the new with the old; and it is often impossible to distinguish the two factors. When we listen, for exanple, to a person speaking—and espeoially when we read a printed page—much of what we seem to hear or see is really supplied by memory. We overlook misprints, supposing that we see the right letters, though the wrong ones are actually before us. In the last few lines we have intentionally made a couple of misprints. Did the reader notice them?

The following figure is taken from Jastrow. Looking at it from a distance, the reader will probably feel that he can almost *see* faint lines suggested by those drawn. They come not from pure sense-perception, but are suggested by memory and imagination.



Another case, given by James. "It is a reminiscence of my own. I was lying in my berth in a steamer when, on turning my eyes to the window, I saw that the chief engineer of the vessel had entered my state-room and was standing looking through the window at the men at work outside. Surprised at his intrusion, and also at his intentness and immobility, I remained watching with half-closed eyes, wondering how long he would stand thus without speaking. At last I spoke. But getting no reply, I sat up in my berth. Then I saw that what I had taken for the engineer was my own cap and coat hanging on a peg beside the window. The illusion was complete: the engineer was a peculiar-looking man, and I 'saw' him distinctly. But after the illusion had vanished I found it impossible by any voluntary effort to make the cap and coat look like him at all." Children who are afraid to be alone in the dark often suffer from terrifying illusions of a similar nature; and most people, probably, could cite somewhat similar experiences.

But the chance of illusion is much greater under certain psychological conditions. An outstanding case is found at a spiritualistic seance. In the darkened room, a person may dimly discern a vague shape. The darkness; the suppressed emotional excitement; the long strained silence; the lingering after-effects in his mind of all the ghost stories he ever heard away back in his childhood; the eye-strain that comes from peering intently through the gloom; the half-belief (at least) that something uncanny is about to happen; the palpitations of mixed hope and fear; the quick short nervous breathing that seems so loud in the silence—almost as loud as the thumping of his heart; the contagion of the suppressed excitement of others in the circle, whose quick breathing only is heard, and nothing seen; the ever-increasing nervous tension; the tense expectancy! Then suddenly he sees this vague and formless something. It may be anything. But he is told in tense whisper, or in a murmur so low that he is barely conscious of it, that this is the spirit of his dead mother. Is it any wonder if he promptly "perceives" what is suggested; that he "recognizes" in this hazy shape the remembered form and features? Yes, he feels absolutely sure of it! But nine-tenths or more of what he "observes" is supplied by memory and imagination.

Even more striking is the case of a person in a state of hypnotic sleep. For he can then be convinced that he perceives any object which may be suggested to him. He can be utterly convinced of it. Yet in this case there is not even a shadow of objective basis for the hallucination.

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Now a quotation from R. W. Sellars, who himself cites the primary authorities. "A few years ago a painful scene occurred at the University of Berlin. The professor had been speaking about a certain book. Suddenly one of the older students shouted: 'I want to throw light on the matter from the standpoint of Christian morality'. Another student sprang to his feet crying: 'I can't stand this'. The first bawled that he had been insulted. The second clenched his fist and shouted: 'If you say another word——' The first student then drew a revolver, and the second rushed madly at him. The professor stepped between them and, as he grasped the man's arm, the revolver went off. General uproar. At that moment the professor secured order. The whole affair had been a comedy, carefully rehearsed by the three actors, for the purpose of studying the exactitude of observation and recollection. Some of the students were asked to write out at once an account of all that had happened. Others were asked to write it a week later. Others had to depose their observations under cross-examination. The smallest number of errors was 26%; the largest was 80%. Words were put into the mouths of men who had been silent spectators; actions were attributed to the participants of which not the slightest trace existed in fact; many essential parts of the tragi-comedy were completely lost from the memory of a number of the witnesses."

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Even at the time of observation there is this danger of confusing what is actually perceived with what is supplied by earlier memories and by imagination. And

we should note that the position is not affected by the fact that the persons concerned feel absolutely convinced that their observations were accurate.

But how much greater is the danger of unconscious distortion when the observation, instead of being fully and carefully recorded at the time, is merely "remembered" after a lapse of days, months, or even years!

Of practical safeguards against distortion and elaboration, the most useful is the recognition of our liability to distort and elaborate. We should fully recognize this in connection with our own observations; for such recognition enables us, to a large extent, to guard against it. Moreover, our recognition of this danger will make us more critical of—less ready to accept at their face-value—reports of what others say (and believe) that they have observed. A great deal turns on the mentality of the observer; on his state of mind at the time; and on the circumstances in which the observation was made. Very important it is, also, to know how soon after the observation a careful record was made of it. Where observations have been "remembered" for any length of time, we need to be still more critical—fully alive to the further danger of unconscious distortion or elaboration during the period of memory.

RELIABILITY OF AN OBSERVATION

The amount of confidence which we should place in any particular observation (our own or another's) must be judged by reference to :

(*a*) The subject-matter;
(*b*) Circumstances at the time of observation;
(*c*) Whether the observation was casual or deliberate;
(*d*) Type of mind possessed by the observer, and his state of mind at the time;
(*e*) Whether the observer was fully aware of the danger of unconscious elaboration and distortion, both at the time and afterwards;
(*f*) Length of time which elapsed between the observation and its being recorded;
(*g*) Amount of confirmation forthcoming from other observers;
(*h*) Whether the fact believed to have been observed is consistent with our whole system of scientifically tested knowledge.

It is evident that much more reliance may be placed upon an observation which can be *repeated* than upon one which cannot. A scientific experiment, for example, besides having many other important advantages, can be repeated again and again by the same observer; and it can be repeated by other observers as often and as carefully as required. A "scientific fact" is therefore a thousand times

stronger than the kind of fact which cannot be observed more than once—*e.g.* the kind of fact dealt with in history, or most of the facts reported by newspapers, or "established" in law courts. Both history and law have their own critical methods, though these are much weaker than the methods of science.

When we come to consider reports in *newspapers*, it is very interesting—and very useful—to make our own estimates of the degree of confidence we can place in them. It will be readily seen that different kinds of reports differ enormously in reliability—though they are all published in such a way as to suggest that they are all equally reliable. This is a great failing of the modern press. Moreover, many newspaper reports are based on observations which—tested as indicated on the previous page—are seen to be of *no* value whatever.

TESTIMONY (AS TO FACTS OF OBSERVATION)

We are obliged to accept many facts of observation on the testimony of others. Usually this is because we ourselves have not observed those facts. But sometimes there is conflict, inconsistency, between what others state that they have observed and what we have observed for ourselves. As a rule, in such cases, we are strongly prejudiced in favour of accepting our

own observation; but this is not always justified. We should endeavour to judge both observations impartially by reference to the points given in the last section; and only then should we decide which is the more reliable.

However, in most everyday matters it is probably reasonable to place more confidence in our own observation than in any testimony. *In considering testimony (as to the observation of others), we are obliged to take into account, not only the possibility of mistakes of observation and mistakes of memory, but also the possibility of careless reporting or deliberate lying.* That is to say, besides considering the points already mentioned, we have to decide what degree of confidence we can place in the good faith of the witness; and there is always a chance that we may be wrong in our estimate. Also there is a chance that we have misunderstood what the witness meant.

Whatever confidence we have in the good faith of the witness must rest upon some rational ground. We must know the man, or know something about the man; and what we know must support the belief that, in this particular case, he is stating what he honestly believes to be the truth. "We should ask too (says Welton) whether any of the general conditions which prompt men to lie are operative in this case. We should ask whether falsehood would appear to bring any personal advantage to the witness; or whether he is likely in this case to be swayed by fear, vanity, sympathy, antagonism, the desire to please, or the wish to astonish." If these conditions apply, they are not decisive; but we should be foolish to

ignore them when estimating the degree of reliance to be placed upon the person's testimony.

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The evidence is, of course, much more reliable if the witness has been thoroughly and skilfully cross-examined. Such cross-examination should enable us to judge both the value to be attached to the observation itself, and also the reliability of the witness's memory; while a skilled cross-examiner may, further, be able to detect and expose any attempt at deliberate falsehood. Evidence which stands the test of searching cross-examination may usually be accepted as reasonably reliable.

All such evidence, of course, is made correspondingly stronger if similar observations have been made by a number of independent witnesses—*provided* that we have independent testimony from each.

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To be properly classified as such, *a Statement of Observation must be rigidly limited to the cases actually observed, and to the period covered by the observation.* For instance, if we (or others) have observed that some Spaniards have black hair, we may not, as a bare statement of observation, say anything more than that: we must not say that most (or all) Spaniards have black hair. It is a fact of observation that "All consumptives who have been examined have tubercular bacilli"; but it is not a fact of observation that "*All* consumptives have tubercular bacilli". It is a fact of observation that the sun has risen every morning during the whole period of recorded history;

but it is not a fact of observation that it will rise tomorrow morning, or that it rose ten thousand years ago.

We may be justified in accepting a Statement of Facts of Observation as either probably or certainly true according to the answers we give to the following questions.

(*a*) LIMITED STATEMENT. Are we satisfied that the statement does not cover any greater number of cases, or any longer time, than is borne out by actual observation?

(*b*) RELIABILITY OF OBSERVATION AND MEMORY. Are we satisfied that both the observation itself, and the memory (or record) of it, are reasonably reliable?

(*c*) GOOD FAITH OF WITNESSES. Are we satisfied that the witnesses are telling what they honestly believe to be the whole truth and nothing but the truth?

(*d*) DIRECTNESS OF TESTIMONY. Is the report first-hand, or second-hand, or tenth-hand, or what? To what extent is the testimony independently confirmed by other witnesses?

THIRD-HAND (OR THIRTIETH-HAND) EVIDENCE

What has been said refers to statements made by a person who claims to have personally observed the facts in question.

But suppose we are dependent upon a reported observation which comes to us only third-hand—or thirtieth-hand—what then? Then we must recognize clearly that the value of the evidence is weakened by every link in the chain. The report now comes to us through a succession of persons, *each* of whom has probably (unconsciously) elaborated a little, exaggerated a little, forgotten to mention certain points. The original observation itself was probably not altogether accurate. The original observer then probably (unconsciously) altered the story, to some extent, in the process of 'remembering' it. What the first person told the second was not, therefore, quite accurate—at the best. Then he, in turn, passed it on, the second person in the chain omitted a few more points from the story as *he* had received it, and also—quite unintentionally—added a few touches of his own. The third person further unconsciously distorted the story—in receiving it; then in 'remembering' it; and then in passing it on. The fourth unintentionally made further changes. And the fifth! And the sixth! And so on! When the report finally reaches us, it will probably be utterly different, in every respect, from the original observation.

It is usually recognized how, in this way, *gossip* or *scandal* spreads and becomes more and more exaggerated, distorted, and untrue. By the time that it has passed through half-a-dozen persons, there is probably not one smallest fraction of the story that bears any relation to fact. This may occur without even one person being guilty of intentional falsehood.

Rumours, of all kinds, are of similar character. *And Rumour is perhaps the most potent force at work in modern society. Rumour rules the world. It is difficult, among one's acquaintances, to discover a single person whose 'mind' on public affairs is not composed mainly of what he (or she) has "heard".* He believes it—on what grounds? He has never considered. He "heard" it. He "heard" it—from whom? From Jones. Jones in turn "heard" it—from whom? Nobody knows. Nobody cares. It "must" be true; or at least there must be "some" truth in it—because it is "common knowledge"! (Better to say, 'common rumour'.)

Perhaps the classic example was the firm conviction of forty million British people, that a large army of Russians had been landed in Scotland, carried by rail to a port in the south of England, and thence shipped to France—in August 1914. For weeks it was "common knowledge", on the very "best authority". Thousands of persons were reported as having actually seen "with their own eyes" the trainloads of Russian troops. Almost everybody in England "knew" personally of someone whose brother or friend had taken part in distributing cigarettes to Russian soldiers while their train was held up

at a station. It is little exaggeration to say that the British public was as *sure* of the truth of that story, as it was of the fact that the Germans had invaded Belgium. Yet—there was not one word of truth in it. The rumour was originally started, perhaps, by a commercial telegram about Russian eggs being landed at Dundee.

Is that an isolated case? It is not. Similar rumours are spread and accepted daily, though perhaps they are not quite so nearly universally believed. Just as most people's conversation, about local persons and affairs, consists mainly of hearing and re-telling gossip—so their ideas about public men and national affairs are composed mainly of rumours. Clear Thinking requires that they be recognized as such.

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Apart from its main facts in broadest outline, *history* consists largely of the record of such rumours as gained general credence in the past. The contemporary letters and journals and other material upon which, for their detail, historians must depend, are mostly notes of what the writers had "heard".

If we go back to earlier periods, we find that we do not now possess even the original records of these stories. We possess—in the oldest surviving documents which tell of the Greeks and Early Romans, for example, or in the oldest documents from which the New Testament was translated into English—only hand-made *copies* of *earlier copies* of still *earlier* written accounts of what the first writers had "heard"

from somebody else, who in turn had "heard" it from, perhaps, the original observer.

When we go still farther back—to the traditional stories of the Greek Heroes; or to the stories of the Old Testament; or to the legends of any early people —there we find nothing more reliable than a tale passed down, by word of mouth alone, remembered and 'mis-remembered' and embellished and 'improved'—from generation to generation to generation . . . perhaps for ten, twenty, or thirty generations . . . and only in the end put into writing . . . and then copied by hand . . . and later re-copied . . . and re-copied . . . with a few copying errors each time. And then translated into another language (with inevitable errors of translation); and then translated into English . . . . It is worth thinking over the fact that the Old Testament, for instance, comes to us thus; and, to a lesser degree, the New Testament also. So do the legends and stories which constitute a large part of all early 'history'.

SECTION V

GENERALIZATION

WHAT IS GENERALIZATION?

WE have seen that every statement of 'observed facts' must be carefully limited to such cases—at such times—as have been actually observed and reported. For instance, we cannot say, as a fact of 'observation', that "All pure negroes have brown eyes"— because *all* pure negroes have not been observed and reported upon.

If, then, a statement covers more cases than have been actually observed, it cannot be said to rest on 'observation'. Yet we do make many statements and we do hold many beliefs of this nature. The important thing to recognize is that they rest, not on observation, but on *inference.* They are based upon a form of inference or reasoning which is known as "generalization". For the moment we may say that this consists of an inference that, because such-and-such a fact has been found in some cases—all the cases which are known—therefore it is equally true of all other cases of the same kind . . . true of 'all' cases.

The germ of this type of reasoning is found even in children and animals. The puppy which has once or twice scorched his nose in sniffing an electric radiator, avoids radiators in future. Of course

we do not suggest that the puppy *reasons* that, because one or two sniffings of radiators were painful, therefore all sniffings of radiators must be painful. Nevertheless, there is evidently some mental-physical process in the puppy, which causes it to avoid all radiators as a result of only one or two experiences.

This is not, in the puppy, a rational process. It is not reasoning—but it is the germ out of which reasoning (of a certain type: generalization) has been evolved.

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To generalize is to infer that what has been found true in 'all observed' cases, is true of 'all' cases (including those which have not been observed); or to infer that what has happened on all known occasions must, in similar circumstances, always happen. It is worth pausing here to make sure that this definition is understood.

Let us take a few examples. Charles Darwin ascertained that, in all known cases, white cats with blue eyes were deaf. That was a fact of observation. But, reasoning from that fact of observation, Darwin made a generalization: "*All* white cats with blue eyes are deaf".

Cuvier, on the strength of all observed cases, made a generalization: "No animals with horns and hoofs eat flesh". Such a statement obviously covered all animals of this kind—all of them, always, everywhere—including millions which had never been observed. It was therefore a typical generalization, a conclusion concerning 'all' based on observation of only a limited number.

Isaac Newton made another generalization when he propounded his famous law of gravitation: that *all* bodies of matter *always* tend to gravitate towards one another; and the strength of the tendency depends upon the mass of each and the distance they are apart—the greater the mass, or the nearer they are together, the stronger the tendency. (In more exact terms: All bodies of matter tend to gravitate towards one another with force which varies in ratio to the product of their masses, and in inverse ratio to the square of the distance between them.) This example prepares the ground for something we shall show later—that our knowledge of all natural laws is a result of this same type of reasoning: generalization.

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There is one point which must be explained here; and it is not easy to explain simply. Every generalization covers "all" cases of the kind referred to. Yet a statement about "most" things of a certain kind, is a generalization (provided, of course, that all things of the kind have not been observed). This is made clearer, perhaps, if we consider, instead of an indefinite term like "most", a definite proportion or percentage. For instance, when we say that 75% of the people of Ireland have a certain characteristic, it is clear that we could not make such a statement without having the total population in mind. We must have them all in mind to enable us to say what proportion of them all have this characteristic.

Any statement about "most" things; or the "majority"; or "nearly all"; or "about half";

or "a large, or small, proportion"; or any term which denotes, even roughly, some proportion of the part to the whole—unless it is a statement of actual observation—must be classed as a generalization. Other terms, such as "some", a "few", or "many", are *not* indicative of generalizations—because they do not indicate the proportion which the cases in question bear to the whole.

A generalization, then, refers to "all" things or events of a certain kind—or, perhaps very roughly, to some "proportion" of them all. But if the statement refers to "some", without indicating what proportion they bear to the whole, that is not a generalization.

TESTING A GENERALIZATION

When are we justified in believing that a certain thing is true of *all* (or a proportion of all) cases, although we have observed only *some* of them? In the next Section we shall see that there is grave danger in careless or hasty generalization; and that many people make false inferences through failure to observe the rules. Briefly, the essential conditions are: First, that the observed cases must constitute a "fair sample" of the whole; and, second, that no conflicting case has ever been found.

The degree of confidence that we are logically justified

in placing in a generalization depends upon the answers we can give to the following questions. These are the tests.

(1) ENOUGH CASES. Are there enough observed cases to support a general statement? It is not possible to lay down a rule as to the minimum number required; but the more cases that are known, the more confidence we can place in the generalization.

(2) VARIETY OF CIRCUMSTANCES. Have the observed cases been found in the widest possible variety of times, places, and circumstances? The wider the variety, the more confidence we can place in the generalization.

(3) SEARCH FOR CONFLICTING CASE. Has thorough search been made for some case which conflicts with the general statement? The more thorough the search, the more confidence we can place in the generalization.

FALSE GENERALIZATION

We may accept a generalization, with a lesser or greater degree of confidence in its truth, according to the answers given to the test-questions above.

There is, however, a very common tendency to generalize on too few cases. It accounts for a great deal of false thinking in everyday life; and we should

make every effort to guard against this error. The practice of testing all generalizations, by reference to the test-questions, is most useful as an aid to clearer thinking.

To take a few examples of careless and hasty generalization: how often do we hear persons generalizing about the characteristics of Germans, Americans, or Australians—on the strength of what they know about only a few of them? Notice how hasty many people are in making general statements about the climate of various places. One town is "too hot"—on the strength of the speaker's having spent one very hot summer there (which may have been a summer when it was exceptionally hot all over the country). Another town is described as "very wet"— on the strength of its having rained heavily on, perhaps, the two or three occasions when the speaker happened to visit it. Similarly, the people of some particular town or community are described as very hospitable; or very formal; or very fond of pleasure; or lazy; or dishonest—often as a result of the speaker's experience with perhaps three or four, or perhaps a dozen, individuals.

I once went to meet a ship which was bringing an acquaintance from England for his first visit to New Zealand. As we walked away from the wharves, it happened that a gust of wind blew up some dust from a patch of gravel near by. "Well," exclaimed my companion, "*it certainly is a very dusty country!*"

Consider such careless generalizations as: "A wet summer is always followed by a dry one"—

supported perhaps by a couple of cases that have been noticed. Or again: "The eldest child usually has more intelligence than the youngest" (or vice versa). Or: "People with red hair have hot tempers".

Some people firmly believe that "Dreams come true". Ask them their grounds for believing it, and they will probably quote one or two cases which they have either experienced or heard about. As a rule, no attempt has been made to look for conflicting cases: indeed, conflicting cases are altogether ignored. The same kind of hasty, careless, intellectually dishonest generalization is a part-explanation of the survival of many superstitions—for example, that certain numbers are 'lucky'; or that bad fortune always follows if we see the new moon first through glass; or that prayers are 'answered'; or that presentiments are reliable indications that some calamity is approaching. Belief in the efficacy of various medicines and cure-alls—if it rests on anything more than a childish acceptance of an advertiser's word—is probably supported only by a pseudo-generalization from one particular case when the taking of the 'cure' happened to be followed by an improvement of health.

* * * * *

Other instances of psuedo-generalization (from too few cases, and ignoring every conflicting case) are found in such assertions as: "Inflation of the currency, once started, cannot be controlled". Or "Every civilization passes through a cycle of growth and decay—youth, maturity, and senility". Or

"Democratic government is bad" (on the strength of our having noticed certain bad features about it). Or, on the other hand, "Democratic government is good" (on the strength of our having found that it has several good features). Or "History repeats itself"—a false generalization based on a few points of resemblance between one period and another.

GENERALIZATIONS: "EMPIRICAL" AND "EXPLAINED"

It has already been emphasized that the degree of confidence which we may place in a generalization depends upon the answers given to the three test-questions. Some generalizations are so strongly established that they amount to approximate certainties. Nevertheless, *we can never have complete confidence in the truth of any generalization so long as it remains purely 'empirical'*. This word means that the generalization stands by itself, without being fitted into our organized, systematized knowledge—in other words, we know that such-and-such a thing *is* so, but we cannot yet see 'why': we cannot 'explain' it.

Consider Darwin's generalization: "All white cats with blue eyes are deaf". This is a perfectly sound inference: it complies with all the tests, and we are justified in placing a high degree of confidence

in it—as an empirical generalization. But we cannot accept it absolutely . . . until we able to explain it. The generalization remains merely empirical until we can discover *why* such cats are deaf; until we can understand the *reason* for it; until we can see the *necessary connection* between, on the one hand, the absence of pigment from the creature's fur and eyes, and, on the other hand, the defect in its organ of hearing.

An ' empirical ' generalization is an inference merely that a certain thing always ' is ' so. Such a generalization, if it complies with the three tests, may be accepted with a high degree of confidence in its truth. But it is enormously strengthened when we are able also to explain ' why ' it is so.

We shall find it a great aid to clearer thinking if we cultivate the habit, not only of testing our generalizations (by the questions already given), but also of classifying them according to whether they are ' purely empirical ' or ' explained '.

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If often happens that a well-supported, carefully-tested generalization remains purely empirical for many years, even for many centuries, before it is finally explained. For instance, it was found by observation long ago that better results were obtained in agriculture by means of a rotation of crops—sowing a different kind of crop every year, in rotation, instead of the same crop year after year. On the strength of this, a most useful generalization was made. But it remained purely empirical: in other words, agriculturists recognized that the rotation of crops *was*

useful, but they did not know *why*. Only after many generations of working on an empirical basis, did men at length discover the explanation of it—*how* and *why* the rotation of crops benefited the soil.

Another instance: For some decades it was observed that certain movements of the barometer were followed by certain changes in the weather. An empirical generalization was therefore made; and weather forecasts were issued on the strength of it for many years. Only comparatively recently has the connection—between movements of the barometer and changes of the weather—been scientifically explained.

The ancient Egyptians and Babylonians made excellent empirical generalizations about the cyclical movement of the stars in the heavens. The Chaldeans observed that eclipses of the moon occurred at more or less regular intervals; and, on the strength of a generalization about it, they were able to predict future eclipses. But the first 'explanations' of these phenomena were not found until more than 2,000 years later.

A general statement of the regular rise and fall of the tide, and calculations therefrom, were accepted and acted upon by millions of seafaring people who lived before Isaac Newton at last explained 'why' the tides rise and fall. The Mendelian laws of heredity are still empirical generalizations. Indeed, all natural laws are generalizations, empirical at first, but eventually explained by our discovering how they are related to still wider laws. These natural laws,

however, even when purely empirical, are very thoroughly tested and verified by the exacting methods of science, so that they can be accepted as a thousand times more reliable, more nearly absolutely certain, than the best of the ordinary generalizations made in everyday life.

We shall next glance at the special features of scientific generalization. Meanwhile the reader may care to test, clarify, and then decide whether he should accept or reject, the following generalizations:

(*a*) "Fish always bite best on cloudy days."

(*b*) "A small receding chin is a sign of weak character."

(*c*) "When different metals are fused together, the alloy is always harder than any of those metals alone."

(*d*) "God tempers the wind to the shorn lamb."

(*e*) "A body falls 16 feet in one second; 64 feet in two seconds; 144 feet in three seconds."

SCIENTIFIC GENERALIZATION

A scientific generalization does not in form, or even necessarily in subject-matter, differ from a crude generalization. That is to say, it is founded on facts of observation: it is an extension of a statement of what has been observed: it is an inference that what has been found by observation to be true of some

things, is true of all things of the same kind; or that what has occurred on some occasions will occur on every occasion when similar conditions exist; or that what has been found true in a certain percentage of cases in a "fair sample" will be true in the same percentage of all cases.

What distinguishes a scientific generalization is the method by which it is arrived at, the thoroughness with which it has been tested, and the precision with which it is expressed.

The most important features of scientific generalization are:—

(*a*) Careful observation under the best possible conditions, by men who are skilled in observation and familiar with the subject-matter; the results of such observation being promptly, fully, and accurately recorded; the observations and record being independently checked by other skilled observers.

(*b*) Observation, wherever possible, of an experimental nature: that is, under conditions which can be varied, one at a time, by the observer.

(*c*) The use of instruments wherever possible to measure and to record, thus eliminating the possibility of error and achieving greater precision.

(*d*) Careful examination, comparison, and classification of facts.

(*e*) Statement of the generalization in clear, simple, and precise terms, and where possible in a mathematical formula.

(*f*) Thorough search, in the widest possible variety of times, places, and conditions, for facts which would be inconsistent with the generalization proposed. An important feature: publicity. The whole scientific world is invited to re-examine, criticise, and test, and to join in the search for inconsistent facts.

These conditions apply, not only to scientific generalization, but also to scientific interpretations of fact (*i.e.* theories). *Scientifically tested generalizations and scientifically tested theories are sometimes called "natural laws"*. Usually we cannot test them for ourselves, but must accept them on the judgment of the recognized expert authorities.

SECTION VI

EXPLANATION

HOW WE 'EXPLAIN' A FACT

A FACT *is said to be explained when we have not merely established that it 'is' so, but also have come to recognize its necessary connection with other facts—to see how this particular fact is related to, and depends upon, other facts.* It is thus, when explained, no longer an isolated fact. It is now understood as part of the universal order, the universal system, a fragment of the 'pattern' of the universe.

There are four kinds of explanation. First, we analyse and explain a thing by recognizing its essential component parts and the necessary relations between them—understanding how those parts fit together to make up the whole. This is termed Explanation by Parts or Factors.

Second: a thing may be explained by our seeing its necessary connection with other things and conditions outside itself—seeing how this particular fact fits into and is dependent upon the other parts of a larger 'pattern'—and how this fact would not exist except under certain conditions. We may call it Explanation by Circumstances and Conditions.

Thirdly, a fact can be explained by our recognizing it in terms of cause and effect, seeing how and why it occurred—the conditions which caused it. This may be termed Explanation by Cause and Effect.

The fourth and last way of explaining a fact is by recognizing its necessary bearing on other facts—how some particular result would not occur in the absence of the fact we are explaining. In other words, we recognize this fact as a means to some end—seeing how it constitutes an essential factor in some process, or in bringing about some result. We may name this, Explanation by Function.

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In the following pages, there will now be considered separately :—

(*a*) How we ' explain ' by Parts or Factors.
(*b*) How we ' explain ' by Circumstances and Conditions.
(*c*) How we ' explain ' by Cause and Effect.
(*d*) How we ' explain ' by Function.

HOW WE ' EXPLAIN ' BY PARTS OR FACTORS

Children, savages, and the majority of persons living to-day, even in a civilized community, are content to take things as they find them. They feel no curiosity about the composition and structure of things, or about the way in which things ' work '. It

is true that young children soon begin pulling things to pieces—" to see what they are made of ", as proud parents are apt to assume. But a desire to see what things are made of—really to understand their structure—is quite a different matter from childish curiosity merely to " look what's inside ". The desire to understand the composition and structure of things, to understand the relation between the parts and the whole, is not a desire that comes early in the development of either the individual or the race. It is remarkable how incurious primitive savages are. About as incurious as is the average lady motorist about what is under the bonnet of her car ! Or the average man about what is going on under his own hat !

In course of time, however,—first as a means to some practical end, and then perhaps for the sheer love of discovery—some men do begin to investigate the nature of things. Then they discover that all things of the same kind have similar structure. They examine the component parts of a thing; and gradually they come to understand the relations between the various parts, and between the parts and the whole.

Let us take J. Welton's illustration, a watch. " A watch consists of various wheels, springs, and other works. *But these do not constitute a watch*—unless they are put together in a certain definite way. The watch is not merely the sum of its parts : there is no watch unless those parts are in certain relations to each other." So is it everywhere in Nature. The human body; the solar system; a drop of water;

moonlight; an opinion; a feeling of anger—each may be analysed to reveal its essential component parts or factors, and their necessary relations to one another. *All things, organic and inorganic, are found to have parts which are arranged in definite patterns or systems: each part has definite and necessary relations to the other parts and to the whole. And without those parts, and that particular arrangement of parts, the thing would not exist as the thing it is. These are the internal 'conditions' of its existence.*

Carrying the analysis further, we find that all the different kinds of material of which all things are composed are really only different complexes or combinations of simpler things. On further (theoretical) analysis, these simpler things are found to be made up of smaller things simpler still. All the thousands of different kinds of matter are formed by different combinations of a relatively small number—probably 92—'elements'. And when this stage is reached, scientists set themselves to carry analysis a stage further, analysing these chemical elements themselves.

Meanwhile, but more slowly and less surely, a similar process is going on in the analysis of 'mind'—its reduction to simpler terms; the sorting-out of the elements or factors in the constitution of thoughts and feelings and motives; the understanding of mental life too in terms of simple, universal "laws".

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Thus we begin to discover order, regularity, system, in the structure and composition of all things. It is not evident, especially in inorganic matter, when we have only such facts as may be perceived by our

unaided senses. But it begins to be apparent when more facts become known to observation through the use of microscopes, etc. Still more facts are found: inferred facts. Gradually—more and more as we come to know more and more facts—order, regularity, system is revealed in the way in which things are constituted.

This, then, is *the first type of explanation—the way of 'explaining' a thing by recognizing how it is constituted; its essential component parts or factors; and the relations that those parts or factors necessarily bear to one another; the arrangement and functions of the parts in reference to each other and to the whole.*

The only components we need take into account are the thing's 'essential' components; and, of their inter-relations, the only ones to consider are those which are 'necessary'. But how can we know that a certain component part is essential, or that a certain relationship between the parts is necessary? Only when we can show that its non-existence would be inconsistent with some scientifically tested generalization—or, in other words, some known natural law. The law can be applied to show that, without this component, or without this internal relationship among its parts, the thing itself would not exist as the thing it is. Thus is a fact explained by reference to its component parts or elements.

HOW WE 'EXPLAIN' BY CIRCUMSTANCES AND CONDITIONS

Now we come to consider the second type of explanation, which refers to the circumstances, the external relations, the conditions, of the thing we wish to explain.

Primitive man regards 'things' as complete, self-existent, self-sufficing entities. He does not recognize that they are but parts, fragments, of a larger system of facts. To quote Welton again: "Savage man never looks at his world as a whole. For him it consists of independent things. He thinks of 'things' as independent pieces of reality, whose nature is not affected by the relation in which they stand to one another. In other words, he regards the world as consisting of a number of separate, self-existing things, whose relations with one another are purely accidental. From this point of view, 'things' are units of existence which can be re-arranged in any way—like a set of ninepins or billiard balls—without altering their nature".

For instance, although primitive man has always seen a rainbow opposite the sun, he does not recognize that these relative positions are absolutely essential to the existence of the rainbow. He would not, therefore, be incredulous if told that a rainbow had been seen with the sun at its centre. He sees red clover and he sees humble bees; but he does not realize that there is any *necessary* connection between the two.

In the days of the early Greeks, the ordinary person had always observed men's heads on men's bodies, and horses' heads on horses' bodies. But he did not understand that this particular relationship was the only one possible; and he was thus quite prepared to believe some legend or traveller's tale about creatures with the heads of men and the bodies of horses. Why not? He had no appreciation of the fact that human nostrils could not pass enough air to fill a horse's lungs—or that the balancing mechanism in a man's head would be useless to a horse—or that the human head could not be, if supplied with horse's blood—or that, for a hundred other reasons, a head like a man's could not, absolutely could not, exist in relation to any type of body differing from a man's.

Again, men in early times observed the sun apparently moving across the sky; and they saw people on earth. But it did not occur to them that, not merely the existence of the sun, but the "movement" of the sun also was essential to the very existence of people on earth. They did not understand that if, for one second, the sun ceased to "move" (the earth ceased to rotate), there could no longer be people. So, in those times, there seemed no reason to disbelieve an Old Testament story about the sun having once "stood still" for awhile, to allow one little tribe to defeat another in battle.

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We do not find figs growing on thistles; nor fig-trees bearing fruit at the wrong season of the year; nor polar bears living in tropical jungles; nor sturdy self-reliant children bred in homes where they are

pampered and spoilt; nor water freezing at sea-level at a temperature of 40 degrees; nor pleasantly smiling faces on men berserk with rage; nor oak trees thriving on the sea-shore. . . .

Every fact has innumerable *necessary* relations to other facts. But, as Welton points out, it was only with the birth of modern science that men began to appreciate the importance of this inter-relation of facts. Modern science began with the discovery that the very nature of things is affected by—their very existence depends upon—their relations to one another.

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Thus we begin to discover order, regularity, system in the relations of all things to other things. As we come to know more and more facts, both observed and inferred, gradually we come to recognize that they, in all their inter-relations with one another, form fragments of a 'pattern'. It becomes increasingly probable that the whole Universe of Fact is cosmos, not chaos: that it forms a Universal Pattern, of which we—as when fitting together a few of the pieces of a jig-saw puzzle—can now perhaps begin to recognize some fragments.

This is the second type of explanation—when we 'explain' a thing by recognizing how it is necessarily related to other things; how it depends upon its relation to other things for its own nature and existence. In other words, we can explain a fact by recognizing the necessary circumstances or conditions of its existence. We do this by showing that the existence of the fact in question, in the absence of those conditions, would be inconsistent with some scientifically tested generalization or natural law.

HOW WE 'EXPLAIN' BY CAUSE AND EFFECT

Hitherto we have been considering the necessary relations between facts which exist *at the same time.* But we find also that there are certain constant relations in *the sequence of facts in time*—between the facts of one instant and the facts of the next.

To the primitive mind, as we have seen, the combination and arrangement of things at any given moment seem quite haphazard and chaotic. But the sequence of facts, the course of events, the facts of one moment in relation to the facts of the next: these seem, to the primitive mind, equally haphazard and erratic. Primitive man was able to imagine that almost anything might happen—in any circumstances —at any time. It was not, to his mind, incredible that a stick might become a snake; that the Nile might rise in answer to prayers and incantations; that a donkey might begin speaking Hebrew; that the sun might "go out" at the bidding of a stranger named Christopher Columbus from beyond the seas; that mountains in New Zealand might quarrel and one of them, in a 'huff', might remove itself ninety miles from the others; that Buddha might be begotten in his mother by a ray of moonlight; that a comet might suddenly appear from nowhere to warn a king that he must die. . . .

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However, as man begins to acquire more knowledge, more insight, he begins also to recognize that there is

some order and consistency in the course of events. *He discovers that, whenever certain conditions occur, a particular event invariably follows; and that this event never happens except under the right conditions.* Then he analyses the whole situation, and ascertains which of the factors in it are 'essential'—that is to say, if they are omitted the event in question does not follow. These essential factors in the situation are called the "cause" of the event: they are the cause, and the event which follows them is their "consequence" or "effect". This discovery of a constant relationship between cause and effect is expressed as a scientific generalization or natural law.

Here, then, we have the third way of 'explaining' a fact—by recognizing it as the effect, the inevitable effect, of the circumstances from which it arose. Among all the elements in the situation which preceded the event, we find those which were necessary to 'cause' the event in question. In other words, we show how—all the circumstances being exactly what they were—the non-occurrence of this event would have been inconsistent with some known natural law.

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It is important to keep the foregoing definition in mind. In everyday life there is much loose talk about the 'causes' of events. For instance, we may hear people speak of the assassination of an Austrian archduke as the cause of the war of 1914–18. Or they may say that the economic rivalry of certain nations was its cause. Or someone says that sitting in a draught was the cause of his contracting a cold.

Or that the captain's negligence was the cause of the ship running aground.

Now, strictly, none of these constituted a sufficient cause of the event which followed. An Austrian archduke was assassinated, and, *in all the circumstances existing at the time*, a European war resulted. But, had the circumstances been different, a dozen archdukes might have been shot without war following. Clearly, then, the assassination was only one factor; and the 'cause' of the war must be found in *all* the essential factors of the pre-war situation. Similarly, sitting in a draught does not necessarily, invariably, result in one's catching a cold. There must have been a certain bodily condition at the time, and also there must have been the presence of certain germs. It was all these facts in combination which really constituted the 'cause' of catching that cold.

But there is no call to be pedantic. If all the other conditions were normal and as usual, then they can be taken for granted. For ordinary unscientific purposes it is then sufficient to mention only *part* of the cause—namely, the special or unusual factor or factors in it. The rest can be 'understood'. Thus I arrived late at my office this morning 'because' I stopped to speak to a man whom I met on the way. Actually, that was only one of many relevant facts—the time of my starting out, the pace at which I walked, the route by which I went, and many others. But, since all the other circumstances were more or less normal and usual, it is sufficient for me to mention, as the cause of my being late, only the one extra fact. This kind of statement would not suffice, however, if

we were engaged in precise scientific discussion. Nor would it suffice to explain, say, the war of 1914–18 —for then there were many other circumstances, besides the assassination of the archduke, which were by no means so usual that they might be merely taken for granted as not worth specifically mentioning.

We should make sure that our statement of the 'cause' of anything includes all the essential facts—except, perhaps, those which are so well known that there is no fear of their being overlooked even though not specially mentioned.

"POST HOC, PROPTER HOC"

A fallacy common among uneducated people is that of "*Post hoc, propter hoc*". (This came *after* that, and therefore this must have happened *because* of that.) In other words, it is the fallacy of arguing that, because one thing follows another, the second must be the effect or consequence of the first. We have seen, however, that, in order to prove a true cause-and-effect relationship between two facts, it is necessary to do far more than show merely that the second fact followed the first. *We have to show that, all the circumstances being exactly what they were, the non-occurrence of the second fact would have been inconsistent with some known natural law.*

Yet we do very frequently find people arguing on the basis of "Post hoc, propter hoc". The classic

instance was quoted by John Stuart Mill, who told how some village folk contended that the 'cause' of quicksands forming off the coast was the building of a certain church steeple. "Before the steeple of Tenterton Church was built, there were no quicksands off this coast; but soon after it was built the quicksands appeared." Similarly, it is often argued that some political measure must have caused an improvement (or otherwise) in business—the only evidence being that the improvement (or otherwise) was noticed soon after the Act was passed. Indeed, it is no exaggeration to say that most politicians owe their reputations largely to this fallacy. Of course, there *may* be a necessary connection between the two things; but to prove this we must show that the change in business would not have occurred without the legislation. If this can be shown, then it is not a fallacy but evidence of cause-and-effect.

You took a bottle of medicine, and soon afterwards your cold—backache—whatever it was—disappeared. Good. Well, your taking the medicine *may* have been the cause . . . or it may not. That still remains to be proved; and the bare fact that the one thing followed the other is not sufficient to prove it. We may sometimes suspect that doctors, as well as politicians, find the fallacy of "Post hoc, propter hoc" helpful to their reputations.

A priest or parson prays for rain—or for a good harvest—or for the recovery of someone who is ill—or for victory in war—or for "peace in our time". In former ages and among more credulous folk, this

making of incantations and prayers was probably, from the people's viewpoint, the most important business of the Church. And if the desired thing happened, then, of course, "post hoc, propter hoc": the rite or prayer had been 'answered'. If the desired thing did *not* happen—well that, even if it could not be explained, could perhaps be explained away!

Why did Greco-Roman civilization decay? It is often amusing to hear somebody trying to account for it by selecting some particular fact—of which he personally disapproves—and showing that this fact was 'followed' (maybe centuries later) by the crumbling of the Roman Empire. Another instance of the fallacy is found in the widespread belief that the troubles which have come upon the world since 1918 are all a result of the War—or else of the Versailles Treaty. In an earlier generation, most of the troubles of the time were attributed to—because they happened to follow—the commencement of State education; or the discovery of evolution; or the extension of the franchise; or the decline of church attendance; or the neglect of the classics.

Similarly, arguing on the basis of "post hoc, propter hoc", the rise in the prosperity of England after 1840 was attributed to the adoption of Free Trade—while the increased prosperity of Germany was attributed to her adoption of a Protective Tariff.

It is important to understand this fallacy and acquire the ability to 'spot' it at first glance. To prove that one fact is the cause of another, it is not enough merely to point out that the second followed

the first : we must be able also to show the *necessary connection* between the two—to show that, in all the circumstances, the non-occurrence of the second fact would have been contrary to some known natural law.

HOW WE 'EXPLAIN' BY FUNCTION

The three preceding types of explanation refer to those relations with other facts which are necessary to the existence (or occurrence) of the fact we desire to explain. It must be constituted of certain component parts or factors; it must have certain contemporary external conditions; and it must be a necessary result of some preceding events known as its 'cause'.

In this fourth type of explanation we change our viewpoint. *We now consider, not what other facts are necessary to make possible the existence (or occurrence) of this fact—but the way in which this fact is essential to the existence or occurrence of some other.* It is still a matter of discovering the 'necessary relations' of this fact to other facts. Now, however, we are regarding necessity in, as it were, the reverse direction : how this fact is necessary to bring about some other fact—not how others are necessary to bring about this one. *This type of explanation applies especially to living organic bodies and facts associated with them.*

Thus we may partly explain the fact of our possessing a nose by reference to its functions. We may explain the humble bee, partly, by showing how it assists in the fertilization of red clover. We may explain a piece of music partly by showing its effect upon the body-minds of those who hear it. We may partially explain the chlorophyll of green leaves by reference to its effect, in conjunction with light, upon carbon-dioxide in the air.

At the back of every explanation of this type—as of every other—must be some scientific generalization or natural law. *We show how the law applies to this case: how a certain result would not occur in the absence of the fact we are explaining. In other words, we show that the attainment of the 'end' without this 'means' (or some similar means) would be inconsistent with some established generalization about the natural order of events.*

TESTING AN EXPLANATION

We have found four types of explanation—or, rather, part-explanation; for *we need to explain a fact in ALL FOUR of these ways in order to explain it FULLY.* There are, however, many facts which at present we can only partially explain: we can explain them in some of these ways, but not all.

Is a certain fact fully and satisfactorily explained? Or, if not fully, then to *what extent* is it explained? Our judgment must depend on the answer that can be given to each of the following questions:

(1) *Do we see how it is constituted—its essential component parts or factors—and their necessary relations to one another?*

(2) *Do we recognize its necessary circumstances and conditions—how it depends on other (external) facts for its very nature and existence?*

(3) *Do we recognize it as the inevitable result of the circumstances from which it arose—the effect of a recognized cause?*

(4) *Do we recognize the necessary bearing of this fact upon others—how some other facts would not occur in the absence of the fact we are explaining? In other words, do we see its 'functional' significance?*

SECTION VII

THEORIES

WHAT IS A THEORY?

THERE is a common saying: "That's all right in theory, but it doesn't work out in practice." About this, there is only one thing to be said: If it does not work out in practice, then it *cannot* be all right in theory. *No theory can be true unless it fits the relevant facts;* and the only way to test a theory is by applying it to the facts to ascertain if it works out. Such a saying therefore betrays only the speaker's ignorance of the meaning of the word 'theory'.

Again, we know the type of man who loudly proclaims his scorn of all theory and theoretical considerations, priding himself on his own essentially practical mind, based, he will probably tell you, on experience in the hard school of life. He has "no time" for books or theories, he declares: he is quite satisfied with his own common sense. But, of course, he does not understand that he is really boasting only of his lack of ordinary intelligence! For theories are simply attempts at an intelligent interpretation of facts. Apart from deduction (which we shall consider later), *ALL REASONING—THAT IS, ALL INTELLIGENT THINKING—CONSISTS OF MAKING AND TESTING THEORIES.*

Yet again, there is the person who insists that he is "not interested in theories": all he wants are the "plain facts". To him it should be explained that there is no real division, such as he supposes, between facts and theories. *Every true theory is a statement of fact: a statement of fact—about other facts.* Whatever *is*—is a fact (whether we know it or not). Roughly, whatever we think or infer is a theory. If it does actually correspond to fact, the theory is true: if it does not, then the theory is false.

* * * * *

There are two kinds of theory—general and special.

A general theory is a proposition which, if true, is universally true. It covers all things or all events—all, always, everywhere—of the class referred to. A generalization is a simple type of general theory. An explanation also is 'general' if it applies to all things, or all events, of the sort that are being explained. These general theories, however, have already been considered in this book; and we shall now pass on to discuss special theories.

A special theory refers to one particular set or selection of facts. It is an attempt to explain them in their relations to one another. The theory must fit all the 'known' facts to which it refers; but it reveals also the identity of some other fact or facts, hitherto unknown.

Figuratively, we may say that finding a special theory is like discovering the 'pattern' into which a number of particular facts—and the general laws which govern them—will fit. Still more figuratively, it is like putting together the pieces of a jigsaw puzzle from

which one or more pieces are missing. When we have fitted together all the pieces available (the known facts), we can see what the missing pieces must be like to enable them to fit into the gaps.

TESTING A THEORY

A theory may be " possible ", " probable ", or approximately " certain ".

In judging the degree of probability of a particular theory, we should always bear in mind the following points.

(1) *CONSISTENCY. A theory is not even possible —it must be rejected or amended at once—if it is found to be inconsistent with any known fact (which term includes any known natural law).* This applies not only to such facts as are directly associated with the problem, but to all known facts whatsoever.

(2) *SUPPORT. The probability of a theory depends largely on the number and variety of the known facts to which it directly refers—and which it enables us to explain in relation to one another—* and in relation to all the natural laws which apply. The theory must accurately fit all the known facts that it refers to.

(3) *ABSENCE OF RIVAL THEORIES. Our confidence in this theory is conditional upon*

there not being any alternative theory which at least EQUALLY explains all the facts. If two theories are equal, we must suspend judgment between them. If one, when tested, is stronger than the other, we should provisionally adopt it—but we should not forget that an alternative (though less probable) theory exists.

When we are testing any theory, it is useful to put these questions :—

(a) *Is there any known fact or natural law which is inconsistent with this theory?*

(b) *How many facts (of different kinds) are directly referred to by this theory and explained in relation to one another? Does it accurately fit them all?*

(c) *Has every effort been made to formulate an alternative theory?*

PROBLEM-SOLVING THEORIES

Apart from questions which can be answered by evidence of somebody's observation, and apart from those which can be solved by straightforward deduction (to be discussed later), *every 'problem' requires a 'theory' to solve it.*

Here is a simple instance. You see a certain man walking along a street. Where is he going? Well, you know that the man is a practising solicitor; his office is at the end of that street; it is about the usual time of day for professional men to go to their offices; this man is wearing the conventional dress associated with his profession; you cannot find anything which is inconsistent with the theory that he is on the way to his office; and you cannot think of any other place where he is equally likely to be going. Tentatively, then, you infer—you adopt the theory—that this man is on his way to the office. But there are not enough facts to give you any great confidence in the idea. You think: On the evidence that I have—which isn't much—he is probably going to his office. It is a theory, but not a strong one.

Take another case. Suppose that two wrecked motor-cars are found at a lonely cross-roads. Two dead men are there, one of them in a car at the driver's seat, and one lying on the roadside. No eye-witnesses come forward to give evidence. The police therefore need to formulate a theory to submit at the coroner's inquest. What are the known facts which the theory must fit?

Only two bodies have been found; and we infer that each car was driven by one of these men, travelling alone. We notice the relative positions of the two smashed cars; and also the indications that one car took the full force of the impact on its off-side running-board and the off-side of its body. There are traces of tyre tracks on the road, and other marks that suggest a violent skidding of the wheels

of one car. A watch is found in a pocket of one of the men: it is broken, but the hands point to the time, 11.15. Dozens of other facts are observed; dozens of simple inferences are made from them. Finally, a particular theory—a hypothetical "story" of what happened—can be adopted. If there are enough facts to support it, and if it is consistent with all known facts, and if it seems to be the only theory which can be devised to fit the facts—then it can be accepted as, very probably, the true account of how these men met their deaths and who was to blame for the accident. It is a typical 'theory', carefully devised to fit the facts, and thoroughly tested.

But again let us note: what we are concerned with is finding the *most probable* theory. There are not nearly enough facts—there is not nearly enough variety of facts—to justify our accepting the theory as absolutely certainly true. *There cannot be absolute certainty unless we are able to show that ANY OTHER theory would be, not only unsupported by, but definitely INCONSISTENT with some of the facts.*

In this case, for instance, there is not a scrap of evidence to support an alternative theory that, at the time of the accident, there was a third person present; and it was that third person who was driving one of the cars. Then, escaping uninjured, that third person left the scene and said nothing about it—perhaps to avoid being involved in the official inquiry. I say: there is not a scrap of evidence to support that theory. Nevertheless, it is not positively inconsistent with any of the facts that are known. Moreover, there *may* be other facts, overlooked by

the police, such as a woman's footprints among the wreckage, around the bodies, and leading towards a gate in the hedge. Even if there are no observable traces, it is still just conceivable.

Of course we do not attach any credence to this second theory: there is nothing whatever to support it. But the bare fact that it can be formulated, and that it is not definitely inconsistent with the evidence, means that it is at least barely "possible" (see Test 1). This in turn is enough to prevent our confidence in the other theory, the adopted theory, from being absolute (see Test 3). We live and work, however, not by absolute certainties, but by probabilities. The theory adopted in this case is very highly probable. For all practical purposes, that will suffice.

* * * * *

Now let us glance at some other special theories. Any well-constructed detective story affords a good example of the way in which facts are observed, and then theories are formulated and 'tried out' to see how well they fit the facts—whether they enable us to explain the facts in relation to one another; and whether they will enable us to deduce some other facts which have *not* been observed (*i.e.* the identity and actions of the criminal), so that the whole is seen as a coherent 'pattern'.

The good business man, again, is a theorist. If he finds that sales are decreasing, he sets himself the problem: What is the explanation of this decrease of turnover, and how can it be remedied? So he analyses

it to discover its component parts or factors—in which particular lines, and at what particular times, his sales have fallen away. Then he studies the circumstances, both at the time and previously, and he tries to find the cause of this decrease in business. Finally he adopts a 'theory' to fit all the facts; and another theory of what is the best course for him now to pursue.

Similarly, a doctor examines his patient and notes first the abnormal facts, the symptoms. When he has collected all the relevant facts, both normal and abnormal, he tries to find a diagnosis (a theory) to fit them all. Perhaps, for instance, the theory may be that the patient is suffering from deficient activity of the thyroid gland. All the facts about his condition are consistent with that supposition; certain facts—the symptoms—definitely support it (*i.e.* can be explained by it); and there is no other disease known which fits the facts equally well. Therefore the doctor adopts that particular theory, or diagnosis, and treats the patient accordingly.

How do we know that the earth is spherical, and not flat? Our knowledge of this is based on theory—even though it has been so thoroughly tested and so amply verified that it is certainly true. However, we still cannot know by observation that the earth is a sphere. What we know by observation is that the earth's shadow on the moon, at an eclipse, is always circular; and that a sphere is the only shape of a body which will cast a circular shadow in any position. We know also by observation that ships at sea, as their distance increases, disappear gradually,

the lower portions disappearing first; and the same distance gives the same degree of disappearance in any part of the world. This supports the inference of uniform curvature. We know that as we rise in an aeroplane, the horizon extends—we can see tall distant objects previously invisible—and the range of vision extends equally in every direction. This also supports the idea of uniform curvature in every direction. We know, further, that by travelling continually East or West, we eventually arrive again at our starting-point. We know many facts about the manner in which the "fixed" stars change their apparent position in the heavens as we journey North or South. These and hundreds of other facts! The theory that the earth is a sphere enables us to explain all these facts; it is consistent with *all* known facts; and, in spite of every effort, we have never been able to formulate any alternative theory which is even consistent with—far less supported by—the facts of observation. Therefore we can have complete confidence that this theory is a statement of fact.

EVOLUTION

During the last few generations, man has made a discovery the importance of which it is difficult to over-estimate. It is this: that nothing can be fully understood except by reference to its context. The Universe, the Solar System, this Earth, all living

species of plants and animals, Man, man's customs and traditions and institutions: all things are largely *unintelligible*—if we consider only the facts of *any given instant of time.* But they become intelligible when we recognize the continuity of the past and the present. This represents a very great advance of mankind towards Clearer Thinking.

To look at the facts of to-day, isolated from the past, is like our going into a cinema in the middle of a picture—glancing at the screen for a couple of seconds —and coming out. What we should see would be unintelligible. Perhaps a horseman standing by his horse with one foot in the stirrup, either about to mount or having just dismounted, looking intently at a square black box on the ground; while a policeman, his clothes dripping water, rushes from a house in the background, glancing back over his shoulder, carrying a dead goose, and shouting "Less than five yards!" What on earth does it all mean? Goodness only knows! To understand this glimpse of the picture, it is necessary to know what has gone before—what has led up to it.

Similarly with everything we see about us in the world to-day (including the world itself): *to understand the present, we must know something of the past out of which it has grown.* This truth, however, though it now seems obvious, is really quite new to man: only during the last few generations has it become fully realized. But already it has revolutionized the whole thought of educated, civilized people.

To-day we try to see almost everything in the light of its history (Not ' history ' in the old sense of the story of one thing happening—and then another—and then another; but ' history ' in its new sense of one thing *leading to* another). *To-day we try to understand things by trying to recognize the chain of connected developments and changes by which they came to be what they are now.*

We look back over the past forty years and see how the modern motor-car has been " evolved ". We look back over the centuries and see how modern man's dress has been " evolved ". We study the story of the evolution of Parliament, trades unions, moral codes, artillery, and the practice of medicine. Then, passing from the works of man, we have constructed theories—which fit ten thousand otherwise inexplicable facts—embodying the story of the evolution of mountains and valleys and plains, coastlines and caves, the formation of the very rocks and the present arrangement of their strata. Astronomers and physicists combine in the endeavour to find a satisfactory theory-story of the evolution of the Solar System, and even of the Stellar Universe.

* * * * *

There are two sorts of theory about organic evolution, the evolution of living things. The first is the theory that there has *been* an evolutionary process: the second is concerned with the *explanation* of it—how it occurred—its causes and conditions—the manner in which the evolutionary changes were brought about.

The theory that there has been a process of evolution is not new. It was suggested by some of the Greek thinkers more than 2,000 years ago. During the last two or three generations, however, an enormous number of fresh facts have been found, classified, examined; and the theory has been carefully verified, by reference to the millions of facts now known, by tens of thousands of qualified experts in the various branches of scientific research.

This theory of organic evolution is the theory that the species and varieties of living things (both plant and animal) have not always existed as we know them to-day; but that they have "become" what they are as a result of a very long history of change and development, starting, probably hundreds of millions of years ago, from the simplest and lowliest forms of organism. To support this theory, we have now millions of separate facts ascertained and examined by scientific workers in such fields as palæontology (the scientific study of fossil remains), anthropology (the science of prehistoric man), zoology (the scientific study of animals and animal life), biology (the science of vital processes), anatomy (the science of organic structure), physiology, and psychology. From every field the experts have reported that this theory of evolution—

(*a*) is consistent with all known facts;

(*b*) enables them to explain vast multitudes of facts which are otherwise inexplicable;

(*c*) is the only theory devised which is consistent with the facts.

The theory that there has been a process of organic (including human) evolution is thus to-day thoroughly substantiated as an approximate certainty.

* * * * *

The other theories of evolution—the Darwinian theory, the Neo-Darwinian theory, and so on—are designed, not merely to show that there has been an evolutionary process, but to explain the manner in which the changes were brought about. Here we have not yet anything like the same approach to certainty. Indeed, all the theories on this problem are still being continually tested and continually amended. The search for the final, comprehensive theory, which will accurately fit and explain *all* the facts, goes on.

SECTION VIII

DEDUCTIVE REASONING

DEDUCTION

DEDUCTIVE reasoning may be described as the reverse of generalizing.

In generalizing, we start with a number of particular cases, and then reason our way to the formulation or acceptance of some general law or principle. In deduction, on the contrary, we *start* with the general law or principle, and then reason out its application to some particular case.

Here is an example of each process. It has been found that, in all known cases, animals with horns and hoofs are non-eaters of flesh. These are the particular cases, known by observation. On the strength of this, we may generalize that: "*All* animals with horns and hoofs are non-eaters of flesh". This empirically establishes the general law or principle—covering "all" cases (including millions that have never been observed).

In deduction, now, we start with this general law or principle already accepted. The deduction consists of applying it to particular cases; or deciding particular cases by reference to the general law. For instance,

a humorous deduction has been made with regard to the Devil. Apply the stated general principle to this particular case, and you will see that the Devil must be a vegetarian! Or another deduction may be made by applying the general principle to some extinct animal of which the fossil remains have been discovered. We find that this extinct animal had horns and hoofs; and we are therefore able to deduce the fact that it was not a flesh-eater. Thus we learn about the creature something which could not be discovered in any other way. We know it by "deduction".

Nearly all mathematical reasoning is deductive. The task of a lawyer, again, consists largely of considering how the laws of the State apply to particular cases—which is deduction. Every chemist or engineer who refers to a general formula to solve a particular problem, is using deductive reasoning. The term is *wrongly* used, however, by some writers of detective stories, who refer to the detective as making "deductions" from the evidence and clues (which are not general principles, but particular facts). The point to remember is that we can make 'deductions', not from particular facts, but only from general laws and principles.

* * * * *

Every piece of deductive reasoning, when set out in full, must comprise *two* statements leading to the conclusion. First, as we have seen, there must be the general law or principle from which the deduction is to be made. Second, *there must be a statement definitely connecting the particular case (which is to be decided) with that general law or principle. This*

Connecting Statement is essential. Without it, there is no link between the general principle and the particular case in question; and therefore no deduction can be made.

Let us take an example. Suppose the particular case in question is that of the whale; and the question to be decided is, " Are whales fish? "

What general principle shall we invoke? Here is one : " All fish are cold-blooded ".

At once we appreciate the need for a connecting fact. How can we connect the particular case in question (the whale) with that general principle? It will be realized that, unless such a connection can be found, there is nothing further to be said—no deduction is possible.

Somehow the particular case of the " whale " must be connected with the general principle that " All fish are cold-blooded ". But how?

Here is a connecting fact : " Whales are not cold-blooded ". This meets our need. It links up, on the one side, with the particular case in question, and also, on the other side, with the general principle. The connection may be shown thus :

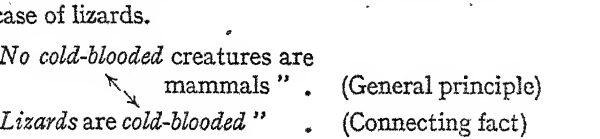
" All fish are *cold-blooded* " (General principle)

" *Whales* are *not cold-blooded* " (Connecting fact)

" *Whales* " . . . (Particular case)

This shows how the intermediate or connecting fact makes connection both ways—both with the general

principle and with the particular case in question. One more illustration, this time with reference to the case of lizards.



The next question for us to consider is: what valid deductions can be made—what logical conclusions can be reached—now that a connection has been found between the general principle and the particular case in question?

DEDUCTIONS: VALID AND INVALID

To make a 'deduction' is to reason that, IF certain facts are admitted, then such-and-such a thing must be true about the particular case in question—because OTHERWISE it would be INCONSISTENT with the facts already admitted.

The facts which must be admitted before any deduction is made, are:

(*a*) The general law or principle;
(*b*) The connecting fact.

These are called the "premises". It cannot be too much stressed that these premises should be

carefully tested before any inference is made from them. We must make sure—first—that both the premises are true. *However logical the deduction may be, if it is made from false premises the conclusion will be worthless.*

We will assume that both premises have been classified according to the 'grounds' on which they rest—that they have been tested—and that they are admitted to be true. Now we want to know what logical inference can be drawn from them. What do they prove? What conclusion do they force us to accept about the particular case in question? And how can we *test* the *validity* of the deduction?

* * * * *

It is not enough to show merely that the conclusion is consistent with the premises. *What we have to show—to be sure that the deduction is valid—is that A CONTRADICTORY CONCLUSION WOULD BE INCONSISTENT WITH THE PREMISES.*

In textbooks on logic, the forms and rules of deduction are set out elaborately and exactly. For our present purpose, however, we can dispense with them. A much simpler method of testing will meet most practical needs. What I advise you to do, is :—

(1) State the general law or principle in the form,

"*All* such-and-such are so-and-so."

or

"*No* such-and-such are so-and-so."

or

"(Some proportion) of such-and-such are so-and so."

A change in the wording of the original statement of the principle may be necessary to effect this. The value of doing it lies in its making us face the question: Is it really a general statement? Does it really cover "all" the things referred to (or an indicated proportion of them all)? *If we cannot make the statement of "all" (or a specified proportion of all)—if we find that we can say it only of "some"—then it is not a 'general' statement, and no deduction can be made from it.*

(2) After the word "All", insert whichever of the following is appropriate:

"All (*and only*) . . . . ."

"All (*but not only*) . . . . ."

For instance, we must say that "All fish (but not only fish) are cold-blooded". Or we may say that "All (and only) citizens were allowed to have slaves in Athens". This will be found most useful as a safeguard against false deduction.

(3) Set out, first, the general law or principle—with the check-words inserted as shown in (1) and (2). Next give the connecting fact. Finally state the conclusion which it is desired to test. For example:

"All fish (but not only fish) are cold-blooded;
These creatures are cold-blooded;
Therefore (?) These creatures are fish."

(4) Test this reasoning. The conclusion is certainly *consistent* with the premises; but *that does*

not prove the conclusion. The real test is to take *a direct contradiction* of the conclusion—to see whether that is *inconsistent* with the premises. If so, then our conclusion is correct. If not, then our conclusion is unproved. For example, test this :—

(*a*) "All fish (but not only fish) are cold-blooded;
Whales are not cold-blooded;
Therefore (?) Whales are not fish."

The contradictory conclusion would be, "Whales *are* fish". We compare *that* statement with the premises and find at once that there is a definite inconsistency. (Try it, and see.) Therefore our original conclusion is valid.

(*b*) "All fish (but not only fish) are cold-blooded;
This creature is cold-blooded;
Therefore (?) This creature is a fish."

The contradictory conclusion would be, "This creature is not a fish". We compare that statement with the premises, and find that there is *no necessary inconsistency*. (This is where we appreciate the value of inserting those words, "not only".) So our original conclusion is *not* valid.

(*c*) "No fish breathe air or suckle their young;
Whales both breathe air and suckle their young;
Therefore (?) Whales cannot be fish."

Make the contradictory statement instead of the conclusion given; and it is at once evident that this is inconsistent with the premises. The conclusion, as given, is therefore proved.

It is worth spending a few minutes in trying out the foregoing examples, especially (*b*), to make sure that the method of testing is understood. The chief point to remember is that *the conclusion is NOT PROVED UNLESS its direct CONTRADICTION is INCONSISTENT with the general premise.*

"CERTAIN" AND "PROBABLE" DEDUCTIONS

So far, we have confined our attention to such deductions as may lead to *certain* conclusions—or, at any rate, to conclusions which are as nearly certain as are the premises from which they are drawn.

Much of our deductive reasoning, however, is such that it can lead only to *probable* conclusions. *The type of reasoning, and also the method of testing it, are precisely the same. The only difference lies in the nature of the general premise. To lead to a 'certain' conclusion, as we have seen, the general premise must be 'absolute'—that is, it must refer to "all" things (or events, or relations) of the class or kind.* Or it must state that, in given circumstances, such-and-such a thing "always" happens.

But, in our chapter on that subject, we have already seen that it is possible to make sound generalizations about a *proportion* of all cases. We may generalize, for instance, that "Most" sailors can climb ropes nimbly; or that "90%" of all sailors can splice ropes; or that "About 40%" of sailors can swim; or that "Usually" lions prefer to avoid men rather than attack them.

Now, such a generalization—we may term it *a proportional generalization—may be used as the first premise in a deduction. But it cannot lead to any 'certain' conclusion. It can lead us only to a 'possible' or 'probable,' conclusion;* and the degree of probability attaching to the conclusion is the same as the proportion of 'all' cases given in the generalization.

If, for instance, we have before us a tested generalization that "90% of all sailors can splice ropes", and if we know that Tom Brown is a sailor, then (nothing else being known) we can reason:

> "90% of all sailors can splice ropes;
> Tom Brown is a sailor;
> Therefore there is a 90% chance that he can splice ropes."

Or if we have a generalization that "Most sailors can climb nimbly", then we may reason:

> "*Most* sailors can climb nimbly;
> Tom Brown is a sailor;
> Therefore he *probably* can climb nimbly."

It should be emphasized again, however, that, in every other respect, the deduction from a "proportional"

generalization must be tested in the same way as a deduction from an ' absolute ' general statement.

It should be stressed, too, that no deduction whatever can be made unless the general premise covers either " all " cases or, at least, a stated " proportion " of all. *No* deduction could be made from any such indefinite statement as: " *Some* sailors cannot swim "; or " *Many* sailors can splice ropes ".

To obtain a ' certain ' conclusion, the general premise must refer to " all " absolutely.

To obtain a ' probable ' conclusion, the general premise must specify (at least roughly) the " proportion " of all.

No deduction whatever can be made from a first premise which refers only to " Some ", " Many ", or the like—too vague to indicate what proportion of the whole it is.

FALLACIES IN DEDUCTION

General Premise not exclusive.

One of the most common of deductive fallacies is that typified by :

" All fish are cold-blooded;
This creature is cold-blooded;
Therefore this creature is a fish."
(Whereas it may in fact be a reptile !)

The safeguard has already been suggested—to make a practice of inserting in the statement of the general premise, after the word "*All*", the additional check-words "*and only*" or "*but not only*". In the foregoing example we should say: "All fish (but not only fish) are cold-blooded". It is worth glancing at a few more cases.

(*a*) "Worry turns the hair grey; Mr. Smith's hair is grey; so he must have experienced a great deal of worry."

(*b*) "Socialists condemn the craving for wealth; Christ condemned the craving for wealth; therefore Christ must have been a Socialist."

(*c*) "Bad workmen grumble about their tools; Samuel Crompton used to grumble about his spinning-wheel; which shows that he must have been a bad workman."

(*d*) "Atheists do not attend church; and, since he never attends any church, it is evident that Robinson is an atheist."

(*e*) "Men who have been self-indulgent and pleasure-loving usually have a bagginess under the eyes (caused probably by late nights); so Jones must have 'gone the pace' in his youth. You see how dark and baggy he is under the eyes."

(*f*) "No prepared nation is ever safe from war; so Britain will be safe only if she is unprepared." (This argument, like several of the previous ones, should be re-stated in the form of general premise, connecting fact, and conclusion. Then it can be tested.)

* * * * *

General Premise neither Absolute nor Proportional.

Another common fallacy results from the failure to make sure that the general premise is either *absolute* (to give a 'certain' conclusion) or *proportional* (to give a conclusion with some specified degree of probability). The safeguard is to insert definite check-words: "All", "always", "most", "usually", or a stated proportion or percentage of cases. Only an absolute premise ("all") can lead to a 'certain' conclusion. It should be borne in mind also that *if the only word which can be properly used is "some", or "many", or any word too vague to indicate what proportion of the whole is referred to—no valid deduction whatever can be made—not even a 'probable' one.* Consider the following.

(*a*) "Scotsmen are thrifty people; and Williamson is a Scotsman." Does it necessarily follow that he is thrifty? Or that, if we know nothing to the contrary, there is a probability of his being thrifty? And if so, what degree of probability?

(*b*) "The Bible should be read in schools, because it is good literature; and good literature certainly should be read in schools." (This argument needs re-arranging, changing the order of the propositions in order to place the general premise first, then the connecting fact, then the conclusion.)

(*c*) "What is unnatural is bad; and therefore the practice of contraception is bad." (The connecting fact must be stated, check-words

must be inserted in the general premise, and the whole argument can then be tested.)

* * * * *

General Premise not stated.

Very often a deduction is offered without the general premise being stated at all. The important fact to recognize is that there *must be* a general idea at the back of every deductive conclusion, even though, in ordinary discussion, it is commonly left unexpressed, assumed, to be 'understood'. Let us take an example:

"This bird cannot be a crow, because it sings."

As a piece of reasoning, this does not 'make sense' at all—*unless* we recognize that it depends entirely upon the unstated general principle: "*No* crows sing". Consider. Suppose this were not taken for granted: suppose we did not have this general idea at the back of our minds: suppose it were, in our minds, an open question whether some crows do sing. What reason should we then have to believe that this bird cannot be a crow—because it sings? The point involved is of so much practical importance that it is worth pausing here a few moments to make sure it is understood.

One of the most common of all ways of 'putting across' a fallacy, is that of leaving the general premise unexpressed. Our danger lies in the fact that we may thus be led to pass an argument that depends upon some assumption which—if it were once recog-

nized—would be instantly rejected. In any case, if the general premise is left unstated, we cannot submit it to the necessary checks before testing the deduction.

If we wish to think more clearly, and to distinguish between true and false assertions, *it is important that we shall establish the habit of 'mentally' filling-in the general idea—if it has not been stated—at the back of every deduction we encounter.* Here are a few examples for practice.

(*a*) "Payment by results would be injurious to the health of the workers because it would stimulate them to work harder."

(*b*) "The enforced co-ordination of industrial activities would be an infringement of individual liberty; and therefore it should be resisted."

(*c*) "Worry turns the hair grey: everybody says so."

(*d*) "Autocratic or bureaucratic government is degrading to the persons governed, because it is government by others."

(*e*) "The girl was nervous: her nostrils were quivering."

(*f*) "Democratic government is not degrading, since the minority bows only to the will of the majority."

SECTION IX

TESTING OUR 'GROUNDS' FOR BELIEF

BARE ASSERTION; DOGMA; TRADITION

BARE ASSERTION—the mere fact that 'somebody' has asserted that a certain thing is true—does not afford any grounds for intelligent persons to accept it. Only very stupid or credulous persons are willing to believe whatever they are 'told' without requiring some sort of reason for doing so. This applies equally to what is read and to what is heard.

However, it is unlikely that any reader of this book will be a person of such low-grade intelligence that he is in danger of accepting bare assertions—*provided that he recognizes them as what they are.* But it is wise to cultivate a definite habit of 'spotting' and (at least mentally) labelling every bare assertion which we come across.

* * * * *

DOGMA is a pronouncement by somebody who does not state his grounds or offer any proof, but relies upon 'prestige' to secure acceptance of his views without question. Usually a mere dogma is accompanied by some kind of threat to those who do not accept it; or else by the suggestion that a refusal

to accept it would be wicked, immoral, or disloyal. Indeed, this association is so usual that it affords us a convenient means of 'spotting' mere dogmas at first glance. *We shall nearly always find that a belief rests on no reasonable grounds, but on dogma alone, whenever it is delivered with an accompaniment of warnings and threats—that those who do not believe will be damned; or will be dismissed, ostracized, or in some way persecuted; or will be regarded by 'the powers that be' as wicked and immoral, or un-British and disloyal.*

The only point to recognize about Dogma is that it is merely Bare Assertion—uttered impressively.

Of course, a statement may often be accepted, as we have seen, without our personally having investigated the evidence and reasoning which support it—and this does not necessarily mean that we have no rational grounds for accepting it. *Provided that all the test-conditions are complied with,* we are justified in accepting the conclusions reached and agreed upon by the recognized expert authorities. And, *provided that all the test-conditions are satisfied,* we may also accept the conclusions reached by certain other individuals in whose judgment we have reasoned and sufficient confidence. But it must be remembered that two essential conditions are: (1) that we have reasoned confidence, based on enough knowledge of the man to enable us to estimate his ability to form a sound judgment; and (2) that we have sufficient confidence in him to make us feel that we should be equally prepared to accept his judgment even if it were the contrary of what it is.

Unless these tests are satisfied, we have no reasonable grounds for accepting a statement offered to us without some degree of proof.

Unless, then, these tests are satisfied, we should classify such a statement as Bare Assertion or Dogma.

* * * * *

OLD AND TRADITIONAL BELIEF. It is obvious that the mere fact that a belief is " old " is no evidence in its favour. On the contrary: that merely means that the belief *must have originated at a time when much less was known* than is known to-day; and when people generally were more credulous about alleged " facts "; less critical of ideas; without the desire (or technique) to examine, test, and verify before acceptance.

CLASSIFICATION: THE FIRST NECESSITY

Whenever we wish to examine any statement or idea—to decide whether or not it is true—we should, first of all, classify it according to the nature of its ' grounds '.

This procedure should be followed in regard to every idea of our own; every statement that we ourselves make; and every statement made to us—whether we encounter it in a book, a newspaper, a speech, or a conversation. The task, at first glance, probably appears formidable. However, the prospect need not daunt us; for *when we have practised this systematically for a very few weeks, we may expect to*

find ourselves doing it—for ever after—automatically, almost unconsciously, without effort.

When the idea has been classified, we should, of course, be prepared to test the grounds for accepting it. After a very few weeks' practice, this also can be done automatically and almost instantaneously. But let us now look, first, at the *classification.*

* * * * *

Suppose we want to consider some assertion, or some statement of opinion or belief, to judge whether or not we have adequate grounds for accepting it.

The first question is: Are we proposing to accept this statement—or reject it, as the case may be—

(1) *On the Judgment of ANOTHER?*

or

(2) *On our OWN Judgment?*

If it is to be accepted—or rejected—on the Judgment of Another, the tests are given on page 133.

If, however, we propose to accept (or reject) the statement on our OWN judgment, then *we must first decide what type of statement it is.* It may be any of the following. Which is it?

(*a*) *A statement of OBSERVED FACTS ONLY*—our own observation, or that of somebody else.

(For tests, see pages 134 and 135.)

(*b*) *A GENERALIZATION from observed facts.*

(For tests, see page 136.)

(*c*) *A THEORY—to explain some collection of observed facts:* to show how they fit together in a 'pattern'—which includes also some other fact which has not itself been observed.

(For tests, see page 138.)

(*d*) *A DEFINITION.* That is, a bare statement of the *meaning* of a certain term.

(For tests, see page 141.)

(*e*) *The result of a DEDUCTION*—a deduction from some Generalization, or Theory, or Definition.

(For tests, see page 139.)

If the statement is *not* one of the foregoing types, then it is probably a mere Assertion, a mere Dogma, or a mere statement of 'Common Belief.' In that case, WE HAVE NO RATIONAL JUSTIFICATION FOR ACCEPTING IT.

That is so important as to be worth repeating, with emphasis. The five types of statement given above, are the *only* types which can afford us adequate grounds for their acceptance. Even a statement which can be classified under one of these headings must still, of course, be tested. But a statement which cannot be so classified—well, it has *no* rational grounds at all, and so there is nothing even to test.

TESTING A JUDGMENT OF OTHERS

JUDGMENT OF RECOGNIZED EXPERT AUTHORITIES.

All four conditions must be satisfied to justify us in accepting a belief on the grounds of Expert Authority.

1. Is he *identified*?
2. Is he *recognized* as an expert authority on this particular subject?
3. Is he *living*? (If not, be careful.)
4. Is he clearly *unbiassed*? Or, if we cannot know this, is there almost general *agreement* on the point among the recognized authorities?

JUDGMENT OF SOMEONE IN WHOM WE HAVE CONFIDENCE

(not being a recognized expert authority).

All three conditions must be satisfied to justify us in accepting a belief on the grounds of this person's judgment.

1. Have we confidence in his ability, rationality, impartiality, and honesty?
2. Do we *know enough about him* to enable us to estimate his ability to form a sound judgment?
3. Have we *sufficient confidence* in him to make us feel that we should be equally prepared to accept his judgment—even if it were the contrary of what it is?

TESTING AN OBSERVED FACT (OR EVIDENCE THEREOF)

WORTH OF THE OBSERVATION

The amount of confidence which we should place in any particular observation (our own or another's) must be judged by reference to :—

(*a*) The subject-matter;

(*b*) Circumstances at the time of observation;

(*c*) Whether the observation was casual or deliberate;

(*d*) Type of mind possessed by the observer, and his state of mind at the time;

(*e*) Whether the observer was fully aware of the danger of unconscious elaboration and distortion, both at the time and afterwards;

(*f*) Length of time which elapsed between the observation and its being recorded;

(*g*) Amount of confirmation forthcoming from other observers;

(*h*) Whether the fact believed to have been observed is consistent with our whole system of scientifically tested knowledge.

EVIDENCE OF OBSERVATION BY ANOTHER

We may be justified in accepting a Statement of Facts of Observation as either probably or certainly true according to the answers we give to the following questions :—

(*a*) *LIMITED STATEMENT.* Are we satisfied that the statement does not cover any greater number of cases, or any longer time, than is borne out by actual observation?

(*b*) *RELIABILITY OF OBSERVATION AND MEMORY.* Are we satisfied that both the observation itself, and the memory (or record) of it, are reasonably reliable?

(*c*) *GOOD FAITH OF WITNESSES.* Are we satisfied that the witnesses are telling what they honestly believe to be the whole truth and nothing but the truth?

(*d*) *DIRECTNESS OF TESTIMONY.* Is the report first-hand, or second-hand, or tenth-hand, or what? To what extent is the testimony independently confirmed by other witnesses?

TESTING A GENERALIZATION

Is it a purely *empirical* generalization; or can it also be *explained*?

Is it an *absolute* generalization (referring to "all" cases), or a *proportional* generalization (referring to a certain proportion of all).

The degree of confidence that we are logically justified in placing in a generalization depends upon the answers we can give to the following questions. These are the tests.

(1) *ENOUGH CASES.* Are there enough observed cases to support a general statement? It is not possible to lay down a rule as to the minimum number required; but the more cases that are known, the more confidence we can place in the generalization.

(2) *VARIETY OF CIRCUMSTANCES.* Have the observed cases been found in the widest possible variety of times, places, and circumstances? The wider the variety, the more confidence we can place in the generalization.

(3) *SEARCH FOR CONFLICTING CASE.* Has thorough search been made for some case which conflicts with the general statement? The more thorough the search, the more confidence we can place in the generalization.

TESTING WHETHER A FACT IS 'EXPLAINED'

Is a certain fact (and this includes a generalization) fully and sufficiently explained? Or, if not fully, then to what extent is it explained? Our judgment must depend on the answer to each of the following questions.

(1) *Do we see how it is constituted—its essential component parts or factors—and their necessary relations to one another?*

(2) *Do we recognize its necessary circumstances and conditions—how it depends on other (external) facts for its very nature and existence?*

(3) *Do we recognize it as the inevitable result of the circumstances from which it arose—the effect of a recognized cause?*

(4) *Do we recognize the necessary bearing of this fact upon others—how some other facts would not occur in the absence of the fact we are explaining? In other words, do we see its 'functional' significance?*

TESTING A THEORY

A theory is a statement which, if true, ' explains ' a given class or complex of facts, some of which are already known, and others of which can be deduced only from the theory. It must be tested by reference to the ' known ' facts covered by it, and to all relevant known natural laws.

A theory may be ' possible ', or ' probable ', or approximately ' certain '. In judging the degree of probability of a theory, we should be guided by the answers which must be given to the following questions.

(1) *Is there any known fact or natural law which is inconsistent with this theory?*

(2) *How many facts (of different kinds) are directly referred to by this theory and explained in relation to one another? Does it accurately fit them all?*

(3) *Has every effort been made to formulate an alternative theory?*

TESTING A DEDUCTION

The reasoning must first be set out in full:—general premise; connecting fact; conclusion. The phrasing can be changed, provided that the original meaning is preserved. If either the general premise or the connecting fact is not stated, it must be supplied before the reasoning can be tested. Check-words "All (and only)", "All (but not only)", or whatever words are appropriate, should be inserted. We should then ask the following questions.

(1) Is the deduction set out in the *correct form* for testing, with the necessary check-words inserted?

(2) Is it an '*absolute*' or a '*proportional*' general premise (covering "all", or indicating a proportion of all)? If no proportion is indicated, no valid deduction can be made.

(3) *On what grounds* does the general premise rest? (Classify and test.) Is it accepted?

(4) *On what grounds* does the connecting statement rest? (Classify and test.) Is it accepted?

(5) Are we sure that there is *no variation in the meaning* of any term which is used more than once?

(6) Taking, not the actual conclusion, but the *direct contradiction* of it, and comparing it carefully with the premises, do we find that they are *necessarily inconsistent*? If so, the real conclusion is valid, or proved. If not, then it is invalid—not proved.

TESTING AN AXIOM AND A DEFINITION

An *Axiom* is an absolute general statement which is so " self-evident " that it is accepted almost or quite universally. But we need to be very careful. *In the history of thought we have seen a thousand times that the axiom or " self-evident " belief of to-day may become an exploded notion to-morrow.* If any axiom is challenged, it must be proved—either as a generalization or as a theory. (Euclid's axioms, for instance, are really generalizations.)

In everyday discussions, if a person declares that so-and-so is an " axiom "—be alert : he is probably expressing a mere dogma. Never be afraid to challenge an axiom.

* * * * *

A *Definition* (which may be used as the general premise for a deduction) is simply a statement of the meaning of some particular term. If a general assertion rests on these grounds—that it is so " by definition "—it is wise to check it by putting it into the form : " The term so-and-so means . . . "

In practice, however, statements of definition are usually met with in a slightly different form; for example—

(*a*) " Democrats are members of an organized community who voluntarily submit to the will of the majority, while retaining their right to endeavour to persuade the majority to change its decision."

(*b*) " Three is one and one and one."

(*c*) " Moral conduct is such conduct as tends to the preservation and welfare of the community, and does not inflict unnecessary hurt or harm on any individual."

The only test which can be applied to a Statement of Definition is the test of agreement. Those who are parties to the argument either agree or do not agree to use the term with the meaning given. If the parties do not agree that such is the meaning of the term, then they are " speaking different languages "; and until they agree to speak the same language no argument is possible between them.

PROBABILITY

We live by probabilities. There are very few absolute certainties in life. When we believe that a thing is " true ", what we should say, strictly, is that, after carefully testing the grounds which support the idea, we judge that it is very highly probable—perhaps " approximately " certain.

To realize this, is to make a big stride forward in clearer thinking.

The important thing for us is to be able to estimate the *degree* of *probability* attaching to each particular observation, generalization, theory, or deduction.

As for any assertions that are offered to us, or any beliefs we find in our own minds, which we have *no* adequate grounds for accepting—let us recognize them as what they are. For, as Josh Billings has expressed it: "The trouble with most folks is not so much their ignorance, as their '*knowing*' so many things which *ain't* so".

SECTION X

PRACTICE

CLASSIFY according to 'grounds', and test the following statements and arguments.

(*a*) "Wholemeal bread is a better food than white bread."

(*b*) "Democratic politicians endeavour to carry out the wishes of a majority of the electors."

(*c*) "It is the personal initiative of the most able that pushes and pulls the rest of the community forward. We all know that such advances as prison reform, the introduction of machinery, the abolition of slavery, the restriction of child labour, the bringing-in of compulsory education . . . were effected by small groups working in the teeth of the bitterest opposition, not only of the vested interests, but also of the great mass of the people." (FLINDERS PETRIE.)

(*d*) "There are probably living and intelligent creatures on the planet Mars."

(*e*) "A people which has lived for generations in a hard environment will be more cautious and thrifty than one which has lived in an easy environment."

(*f*) "A doctor, visiting Constantinople, found that the death rate was disproportionately heavy among the poor people living in crowded basements and cellars. He expressed his belief that this was due to lack of pure air. Constantinople was shocked. 'Blasphemy!' men cried—'A man's death is determined by Allah, and the question of fresh air is irrelevant.'"

(Classify and test the final sentence.)

(*g*) "Halley's comet returns every 76 years (approximately)."

(*h*) Observe cases and make a generalization (if possible) about the greater tendency of fair people than of dark people to sunburn.

(*i*) "Those who break into houses in the daytime are not burglars."

(*j*) "A worker is a citizen: therefore a bad worker is a bad citizen."

(*k*) "Whenever the mere questioning of some belief makes a person annoyed, this is usually a sign that such belief is not held on rational grounds."

(*l*) "I have a headache; aspirin usually relieves it; so I will take some."

(*m*) Formulate and test a theory to account for the fact that, during the last 25 years, there has been a very considerable decrease in the average number of bricks laid per bricklayer per hour.

(*n*) " Moses did not write Chapter 34 of the Fifth Book of Moses called Deuteronomy."

(*o*) " It is clear that wars are caused by financiers, because they are the only people who gain by wars."

(*p*) The early Christians were puzzled by the following difficulty. " If God knows everything, he knows not only our past, but also our future. But if our future is already known, it must be pre-determined—fixed before it occurs—and therefore no effort of ours can alter it. Can we, then, be held responsible for our conduct? "

(Consider the argument.)

(*q*) " If the worst homes produce the most children, the average quality of the people must go down."

(*r*) In deciding whether any action is moral or immoral, ought we to consider the person's intentions or the actual result of his conduct?

(*s*) Sometimes we hear it said: " But you must remember that that man's life is just as valuable to him as yours is to you ". Is it correct to speak of the value of a man's life *to the man himself*? Or does the value of any particular life depend on its *usefulness* to the community—or civilization? Or on what does it depend? (Answer; and then classify and test your answer.)

(*t*) " The speed of light is approximately 186,000 miles per second."

APPENDIX

SOME NOTES ON CAUSATION AND DETERMINACY

FROM a philosophical standpoint, it is well to recognize that Cause and Effect are nothing more than particular instances of some uniform temporal order or sequence which we have discovered in the universe of fact. Some combination of facts, which we will call A, is invariably followed by another fact, B. Then A is termed the cause of B; and B is the effect of A.

We say that there is a necessary relationship between the two facts. But when we say " necessary ", we mean only that it *is*—that always and everywhere it *is*. The general fact that this relationship exists universally is expressed as a scientific generalization or natural law. This general fact may in turn, perhaps, be explained by reference to some even wider law; and this wider law may presently be explained by some other law wider still. But ultimately we must reach a point at which explanation stops: we must find that such-and-such a fact *is* so—is so, universally—and no further explanation is possible; it just *is* so.

Nevertheless, the cause-and-effect relationship is a fact. Nor is it affected by any modern questioning or inference about the true nature of Time. The sequence of events in time may, it is said, be analogous to " the sequence of telegraph poles along the Great North Road ". Even so, it is a fact. Some present-

day mathematician-physicists appear to forget that observed facts, facts of experience, are still *facts*: they sometimes write as though inferred facts were the only ones. (That is the danger in all minds which are too largely devoted to the study of abstractions.) But whatever we eventually accept by inference about the nature of time and space, or time-space, time must still be a fact—a fact of experience. And the sequence of facts in time is still a fact, a fact of observation. And the 'necessary' relationship between cause and effect must still be a fact. Modern mathematical physics (or metaphysics) have in no way "exploded the idea of causation".

* * * * *

But has modern physics undermined the idea that causation is universal—that *every* fact is caused? This suggestion has been made, on the strength of statements that "there are phenomena which cannot be included in any consistent scheme unless the conception of indeterminacy is introduced". Sir James Jeans, for instance, quotes Dirac:

> "When an observation is made on any atomic system in a given state, the result will not in general be determinate, *i.e.* if the experiment is repeated several times under identical conditions, several different results may be obtained. If the experiment is repeated a large number of times, it will be found that each particular result will be obtained a definite fraction of the total number of times, so that one can say there is a definite probability of its being obtained any time the experiment is performed. This probability the theory enables one to calculate. In special cases, the probability may be unity (*i.e.* 100%), and the result of the experiment is then quite determinate."

This brings us to a confusion in the use of the word "determinacy". An event is determined if it occurs in accordance with some universal 'law'—if, in all the circumstances, its non-occurrence would be inconsistent with that law. But we have seen that a scientific generalization or natural law may be either absolute or proportionate. It is not necessary to confine the term to statements about 100% of all cases; for a definite uniformity of, say, 97·2% or 16·8% of all cases is equally a universal 'law'. Whenever a definite probability can be calculated, this means that such-and-such a thing always happens, not indeed in all cases, but in a certain definite proportion of all cases.

If we tossed a penny ten thousand times, we could confidently expect very approximately five thousand of each, heads and tails. True, we cannot predict the result of any one particular toss; but we can say that there is a definite 50–50 chance of its being heads. Now, this is the point: *if there were no 'law'—if there were real indeterminacy—then it would be impossible to calculate probabilities, because in ten thousand tosses the penny would be just as likely to come down heads* 5 *or* 50 *or* 500 *or* 5000 *or* 10,000 *times.* Mathematical 'laws of chance' are no less 'laws' than any others. There is no less uniformity about an event always occurring 946 times in 1000 than about its occurring 1000 times in every 1000. We can be as certain in the knowledge that there is exactly a 94·6% chance as in the knowledge that there is exactly a 100% chance. Mathematical probabilities are, therefore, themselves excellent examples of regularities or uniformities which we have discovered in the universe of fact.

But, it may be objected, if there is only a certain degree of probability—less than 100%—in any particular case, then we cannot accurately predict the

actual result in that particular case. Therefore, it is said, that particular case is not 'determined'. Yet the chances are known; and they could not be known unless they were determined. *Real indeterminacy, we repeat, would render impossible any calculation of chances—because the element of 'freedom' would be incalculable.*

* * * * *

One last point. Cause and Effect, in the final analysis, are only particular instances of some uniform order or sequence of events which we have discovered in the workings of nature. It is usual to suppose that a fact is most satisfactorily explained (in this respect) when we have recognized it as the effect of some cause. No doubt, for practical purposes, that is true; and it is the standpoint adopted in this book. Since the cause comes first in time, we can control events only by introducing the causes needed to produce the effects we desire—or removing the cause if we wish to avoid the effect. We work through *causes.*

From a philosophical standpoint, however, there is surely as much justification for saying that the effect helps to explain the cause, as there is for saying that the cause helps to explain the effect. Since we are dealing simply with "uniform sequences of events"—capable of statement in general laws—can there be any valid reason for supposing that the antecedent explains the consequent any more than the consequent explains the antecedent? If "explanation" means the discovery of the necessary relations of facts with one another (and that is all it does mean), then, those inter-relations being mutual, each related fact must help to explain the other. Fully to appreciate the meaning of any fact, we must therefore recognize its necessary relations with other facts (in time) in *both directions.*

This may not be of any great value practically. But, if true, it is of immense importance philosophically. It means that, if we are entitled to say that an effect occurs " because " of its cause, we are equally entitled to say that the cause occurred " for the sake of " its effect. In other words, the past helps to explain the present; but the present also helps to explain the past. And therefore the future, as well as the past, are necessary to give us a complete explanation of the present. This opens the door to the possibility of a rational belief that Man and the Universe, Life and Evolution, everything that is, and everything that happens, is *for* something. *The outcome of it all —whatever that is to be—will be an essential part of the complete ' explanation ' of it all.*